Gas Journal

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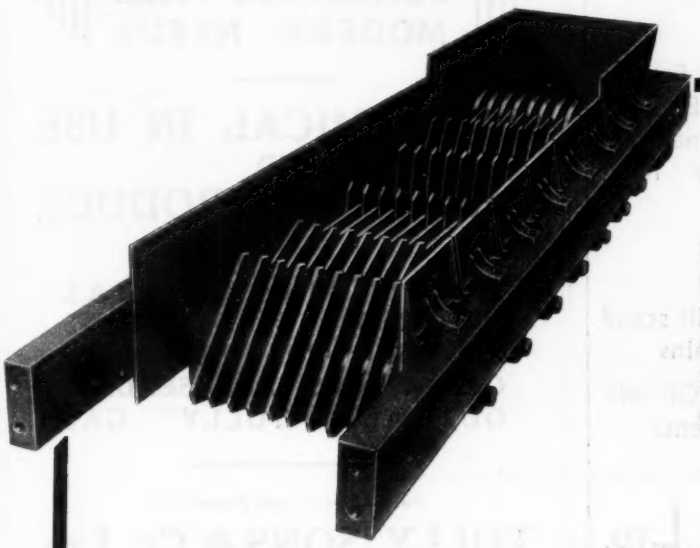

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Gas Journal

JANUARY 23, 1935

Vol. 209. 87th Year No. 3740.

Editorial Notes

Attractive Tariffs

THERE is evidence that the Gas Industry is moving towards attractive gas pricing; there is evidence, too, that in several quarters undertakings both privately and municipally owned are holding back. It is extremely difficult where inaction exists to appreciate the arguments advanced for it, and we ask undertakings to consider in the light of their particular circumstances whether the *status quo* will not lead to a *status non est*.

For years the Gas Industry has been calling for riddance from the " shackles of antiquated legislation." If full freedom has not been accorded by the new laws relating to gas supply, at least a large measure of freedom has been gained. Surely advantage is going to be taken of it? As a matter of fact, it came rather as a surprise to us that, when some of the shackles were removed, many gas undertakings sat still. So general and so bitter had been the cry for years against them that we hoped that schemes would have been prepared and ready for immediate application on the dawn of the new freedom, which was under parliamentary consideration for long enough to enable plans to be matured in optimistic anticipation. Our hope was a pious one, however.

On this question of attractive rate structures we have let the electricians get away with it. We may have had no option in the past, but that is no excuse for indifference to-day. We believe that, if we desire to see gas progress and to extend its services generally to all, the application of some system of tariff other than the flat rate must form part of our desire. And we believe that unless there is universal approval of this contention, coupled with the energy to put it into effect, competition will soon be spelt with a capital C.

Confidence

WHAT is holding back the adoption of attractive gas pricing? We answer this rhetorical question by suggesting that in a great many cases it is due to lack of confidence in the services which gas can render—a lack of confidence which tends to exaggerate the inroads which electricity is making, or is likely to make, into loads which should be held and developed by gas. On occasion gas engineers and managers tell us about the encroachment of electricity into the fields of domestic cooking, heating, and water heating. Seldom, however, when we ask these gas engineers and managers exactly to what extent this encroachment has gone, do we receive a satisfactory reply. The vaguest of information, couched in the haziest of terms, is given in response to such queries as: How much of the cooking load has been lost to electricity; what percentage of the heating load is at present yours; or how has the water heating load gained by electricity affected your future prospects or your last year's revenue? We suggest that if those in charge of gas undertakings were to indulge in a little self-cross-examination on such counts the result would be a gain, not a loss, of confidence.

Service to the consumer does matter enormously; it is the deciding factor as to the form of energy he will employ. The cooking service, the heating service, and the hot water service a consumer can obtain from gas are fundamentally greater than can possibly be afforded by electricity. This must be at the back of our minds when we contemplate new systems of gas charging. *New rates must be formulated in the knowledge that gas can provide superior service.* The approach to the problem must be something like this: " I am perfectly well aware that this new rate, unless the gas consumed increases largely, will result in a considerable loss of revenue. I am confident, however, that the increase in gas consumption will be sufficiently great to give a return in excess of the possible loss." It is platitudinous to say that nothing is to be gained without some risk, but we think that the risk entailed by the adoption of attractive tariffs is largely a figment of the imagination—that the risk looms large with lack of confidence in gas service.

" More Confidence; Attractive Tariffs " is a motto we heartily recommend, not for an indefinite future date, but for to-day.

The Ruhr Gas Grid

THE Yorkshire Junior Gas Association were exceedingly fortunate last Saturday in having with them Dr. Fritz Gummert, Director of the Ruhr Gas Company, who, in friendly gesture, presented a paper on long-distance gas distribution in Germany. This valuable account of the history of the Ruhr gas grid and its present position is published on later pages of the "JOURNAL" to-day and will be welcomed throughout the British Gas Industry. We welcome it especially because the author is at pains to stress the wide difference between conditions in Germany and those obtaining in this country. What may be a perfectly good system of gas supply in Germany may be unwarranted on economic grounds if applied over here. This is a point which we have emphasized on several occasions in these columns. In normal years, the production of pig iron is greater in Germany than in England, and this, of course, means a greater consumption of blast furnace coke. Also, in Germany coal mining involves a greater production of small coal, and the best means of dealing with this is to convert it into coke. From the gas grid point of view, an outstanding consideration is that coal mining is concentrated in a very few districts, and that the Ruhr alone accounts for 70 to 80% of the total German output. Moreover, the collieries are associated with iron and steel works. This is the background of the grid of the Ruhr Gas Company, and it is a background which should be borne in mind by grid enthusiasts in this country.

The Ruhr gas grid is a notable achievement in co-operative organization and in engineering, and one can have nothing but admiration for the skill and determination of its promoters. But the extent of the grid is apt to be exaggerated by the lay Press. In fact, its greatest length is 155 miles, from west to east, the total length of mains being 589 miles. And, to arrive at a proper sense of proportion on the matter, it is wise to bear in mind that the amount of gas sold through the grid is only twice as much as that bought from coke ovens by British gas undertakings at the present time. As we have said, however, the grid is a great engineering feat, and Dr. Gummert's paper certainly contains information which will prove most useful to British gas engineers and administrators. The author explains that the pipes employed, which vary in diameter from 12 to 31 in., are of mild steel, and throughout the joints have been made by welding. At the present time pressures of 3 to 5 atmospheres are used, but the mains are capable of withstanding a pressure of as much as 15 atmospheres (220 lbs. per sq. in.) without difficulty. It has been shown that for short distances large diameter pipes carrying gas at low pressures are preferable, and for long distances higher pressures and smaller diameters.

Position of Municipalities

IT is noteworthy that of the gas supplied through the grid 85% is used for industrial purposes. This naturally levels-up the variations in seasonal demand which would otherwise occur. The daily variations are, in fact, very much greater than the seasonal. The fluctuating demands are coped with in two ways. First, there is storage capacity of 32 million c.ft., apart from the high-pressure storage provided by the mains themselves, which is of no inconsiderable volume. The other means of flexibility is at the coke ovens. If all the available coke oven gas is being pumped into the grid, then the collieries revert to coal slack for steam raising. On the other hand, if relatively small quantities of gas are demanded, then the surplus is used for steam raising. In this way the desired elasticity is attained.

Only 15% of the gas from the grid is taken by the gas undertakings whom the grid could supply; and Dr. Gummert admits frankly that this quantity is far less than was anticipated by the Ruhr Gas Company. He naturally blames the towns concerned, and states that the municipalities regard gas as a welcome form of taxation. He even expresses the opinion that one-third of the cost of gas to the new consumer represents a direct contribution to the rates, and implies that the municipalities do not want to forward the cause of the Gas Industry.

The worth of Dr. Gummert's paper would have been greatly enhanced had he given figures of costs. There is no mention of the cost of the purified gas at the ovens, the incidence of capital cost of the grid, maintenance and depreciation charges, and cost of compression and general working. It would have been most helpful if Dr. Gummert had disclosed at what prices his Company is prepared to offer gas to the municipalities covered by the grid, taking into consideration the nature of the demand and the distance from the source of supply. He simply states that none of the towns which have taken long-distance gas has had cause to regret the decision. All the towns are very satisfied with their supply. As to the future of an all-embracing gas grid in Germany, this question "can only be answered by time."

Fundamental Research

LAST week we had the privilege of inspecting once again the Research Laboratories and work of the Department of Chemical Technology at the Imperial College of Science and Technology. Inaugurated in 1912 for post-graduate advanced study in fuel technology, combustion, explosions, high-pressure gas reactions, electro-chemistry, and chemical engineering, the Department, under the leadership of Prof. W. A. Bone, F.R.S., has carried out a great deal of valuable fundamental research. In the "JOURNAL" for Jan. 23, 1929—exactly six years ago—we published a very full illustrated account of the Department as it then existed. As far as accommodation goes, there has in the interim been no change, but it is obvious that extension of the building in Prince Consort Road is most desirable in view of the importance and growing scope of the Department's work, which in many respects is quite unique. It is, indeed, a most pressing need. Present work is being cramped for lack of space, and no further development can be undertaken unless the building is extended. Plans for extension at an estimated cost of £30,000 are being prepared. The next step is to raise this £30,000; and we hope that this most laudable endeavour will not prove too difficult.

The Gas Industry has, of course, a direct interest in the researches being carried out. The Gas Light and Coke Company is responsible for a general grant and a research fellowship, the South Metropolitan Gas Company for a general grant, and Radiation Ltd. for a general grant and a research fellowship. The work undertaken by the body of exceptionally skilled research workers is of a fundamental character bearing upon "long distance" problems of industry. The Department's policy is based on a bedrock of fundamental research, and the work is uninterrupted by immediate plant problems and the like. In view of this the equipment of the laboratories is unique. The work on gaseous explosions at high pressures, for example, has been extended over initial pressures up to 1,000 atmospheres, the highest yet attempted in gaseous explosions. Again, since January of 1933 investigations have been carried out on certain liquid organic reactions at pressures of 5,000 atmospheres, and with such success that apparatus has recently been installed to extend the work up to

pressures between 10,000 and 20,000 atmospheres. This apparatus, it should be mentioned, has been designed in the Department by Dr. D. M. Newitt. A further example of wonderful equipment is the high-speed camera developed by Mr. R. P. Fraser. By means of this camera astonishing photographs of flame movements have been obtained, showing events occurring in so short a time as one-millionth of a second.

It is our purpose here, however, not to detail the many and varied lines of research which are under investigation at the Department of Chemical Technology, but to suggest that the work is worthy of greater support. It would be a calamity if, through lack of funds, present researches had to be curtailed after having progressed so far and with such good result. It would be a great pity, too, if for the same reason the contemplated extensions to the building had to be indefinitely postponed. In September, 1936, Prof. Bone retires from leadership of the Department. That the success of the Department has been due largely to his inspired direction is common knowledge; and it is to be hoped that he will see the plans for extension well advanced by the time he relinquishes his reins of office.

A Jubilee

THE past half-century has wrought many changes in the Gas Industry for which one is thankful; while there are other things which it is equally pleasing to reflect have remained with us throughout. Ever progressive in its own affairs, the Industry does not forget the work of those who render this progress possible. In itself offering the very best of service, the Industry gives no better than it gets from those who furnish its requirements; the " life " of gas-works and of their machinery and apparatus is proof positive of the truth of this as a general statement. But from time to time the appearance of a fresh " milestone " enables one to particularize, and at the moment we are afforded the real pleasure of congratulating a prominent firm of gas plant manufacturers upon their recent Jubilee announcement.

Fifty years ago, Messrs. R. & J. Dempster purchased the Gas Plant Works at Newton Heath, Manchester, wherein they have since carried out operations which have given them, and have maintained for them, a position in the forefront of the Industry's affairs. May another half-century, at least, of equal usefulness lie before them! The Industry will need good service in the future no less than in the past; and old friends such as these possess every requisite for rendering it. Advantages claimed by the firm in 1885 still remain with them in even greater measure, and, in addition, they have now behind them a vast amount of practical experience in the manufacture of gas plant. " We have realized our successes and written off our failures," says Mr. Charles Dempster in his announcement. So that the way lies clear to continued achievement.

Readers of the " JOURNAL " have already seen on pp. 114-115 of last week's issue the announcement referred to, and no doubt will have been equally intrigued with ourselves by the list of outstanding events —one for each year—of the half-century by which the statement is accompanied. The first of these outstanding events occurred in 1885, when concurrently with the purchase by Messrs. R. & J. Dempster of the works at Newton Heath, the Gas Institute met in Manchester. At later dates, in close order, came the historic Earl's Court Exhibition, the formation of the Society of British Gas Industries, and the Manchester Gas Exhibition; and then, when little more than half of the fifty years had passed, there was the inauguration of the British Commercial Gas Association—also at Manchester, which thus has a big share in the " milestones " of the Industry. Holders and other gas plant with which Messrs. R. & J. Dempster have closely identified themselves find place, too, among the events enumerated. These are reminders of the efficient manner in which the firm have assisted progress in the past, and it is our conviction that they will continue to give this help, in no less abundant measure, in the future. To Messrs. R. & J. Dempster, and to firms like them, one will never appeal in vain for co-operation in the service of the community.

Immorality in the Gas Industry?

IT is an everyday occurrence now to find people—from bishops downwards—discussing matters of morality. Perhaps it might be better to say " problems " of morality, since opinions as to what is moral and what is not are found to differ so widely. Dress, literature, art, and many other things come " under the microscope." But it is rarely indeed that one finds anything associated with the utilitarian gas appliance stigmatized as immoral. This did, however, happen a few days ago, during the discussion on an address by Mr. Stephen Lacey to the Scottish Junior Gas Association, when one of the speakers expressed the opinion that " in Scotland there is a feeling that the hire-purchase system is immoral—that it is not right to receive something which has not been paid for." Now, whatever there is to be said for or against the application of the system to particular cases, we feel that we should protest against any implication that hire-purchase, as such—" receiving something which has not been paid for "—is immoral. Would it be too much to claim that the business of the world is based upon credit, and that hire-purchase is no more than extended credit? The fact that hire-purchase can be abused, by using it to tempt people to assume liability that they would not otherwise dream of incurring, for luxuries which could well be done without, is an aspect that is generally deplored, but which does nothing to vitiate its claims to morality when regarded as a business principle.

If hire-purchase—" paying while you use "—is immoral, what shall be said of the quarterly gas bill, which is settled *after* the gas has been consumed; or of the butcher's bill, which comes along *after* the meat has been eaten? Rightly employed, hire-purchase, deferred payment, extended credit—call it by what name you will —has been one of the most potent influences for good that the present troubled world has brought to the front. Houses everywhere are being gradually bought, and with the very first payment the purchaser acquires a stake in the country and an added feeling of responsibility. Inside these houses—thanks to facilities for hire-purchase —are millions of articles which add to the comfort and dignity of the home, but which could not have been secured had no such terms as these been available. Often, indeed, are thus made possible even marriages during the years that are rose coloured, which would otherwise have had to be postponed until after the arrival of the time of disillusionment. Only a day or two ago we read in *The Times* the statement of their Art Critic that, " after the most careful consideration, it is difficult to find anything—except a certain amount of risk to the dealers—but the promise of good in the plan for the hire-purchase of pictures initiated by Messrs. Arthur Tooth & Sons. That it is likely to create a new class of picture buyers is, as a matter of fact, already proved." No, we cannot regard it as being right to dub " immoral " the source of so much good—hire-purchase.

Coming back to our own Industry, the evidence is much the same. Mr. Lacey, in his reply to the discus-

sion, while admitting that the feeling that it is not right to "receive something which has not been paid for" exists to some extent in England, added that "the fact remains that it is the only way to sell appliances." Just so; it is the only way in which multitudes of people can buy them. The day may come when all and sundry will be able to stroll up and produce the money for a gas appliance as they now do the penny for their morning paper. But that day is not yet; nor are there any signs of its approach. And there are so many attractive gas appliances! Whenever they are displayed, crowds congregate around the beautifully enamelled cookers and the gas fires of multifarious pretty patterns and as many tempting colours. They are there waiting, and we will not believe that there is anything immoral about a business proposition which can bring about their transfer to those homes of the people which are governed by a purse of dimension not too long. Hire-purchase of beautiful and efficient appliances is a contribution by the Gas Industry to "the greatest happiness of the greatest number," and the acceptance of such a contribution must not be thought immoral.

A New Industrial Outlet

THERE are a number of points of interest in the "Ferrolene" cutting process to which reference is made on later pages in connection with a demonstration at Watson House to representatives of the various Industrial trial Development Centres. In the first place, a saving of 33 to 40% over the acetylene process is claimed, together with a definite economy with oxygen due to the narrower cut. Other advantages include less danger in handling than with acetylene due to its being impossible to cause the burner to blow back—even if the nozzle be placed right up against the work. The surfaces of the cut are not oxidized, with the result that they are much more easily machined. No great advantage in the speed of cutting is claimed, but the cost is definitely lower, while—an important point this from the labour viewpoint—the process is non-injurious to the operators' eyes, the flame being non-incandescent. There is, moreover, no residual sludge.

The uses to which the "Ferrolene" process can be put are numerous. In addition to the cutting up of scrap steel in shipyards and elsewhere, it may be utilized for the cutting of new plates in steel mills, foundries, and general manufacturing plants; in the place of hydrogen in the manufacture of hard glass and radio broadcasting tubes. Undertakings with any potential applications for the process—and few surely have not—will be well advised to acquaint themselves with details of the installation through the medium of their Industrial Development Centre.

Forthcoming Engagements

January.

24.—B.C.G.A.—Yorkshire District Meeting, Leeds.
25.—B.C.G.A.—Northern District Meeting, Newcastle-on-Tyne.
25.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and paper by Mr. S. F. Dunkley.
26.—WESTERN JUNIOR ASSOCIATION. — Visit to Gloucester.
29.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W.1, 2.30 p.m., preceded by a Committee Meeting at noon.
31.—B.C.G.A.—South-Western District Meeting, Exeter.

February.

5.—I.G.E. Research Executive Committee, 2.30 p.m.
6.—MANCHESTER AND DISTRICT JUNIOR ASSOCIATION.—Visit to Messrs. Parkinson & Cowan's Meter Works, Stretford, and Paper by Mr. W. Hodkinson.
7.—MIDLAND JUNIOR ASSOCIATION.—Meeting and paper by Mr. A. Knight.
9.—WESTERN JUNIOR ASSOCIATION. — Meeting at Bridgwater.
9.—SCOTTISH JUNIOR ASSOCIATION (EASTERN DISTRICT). Visit to Leven. Paper by Mr. C. L. W. Berglin.
9.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Meeting and paper by Mr. T. R. Sawers.
11.—I.G.E. General Purposes Committee, 3.15 p.m.
12.—I.G.E. Council Meeting, 10 a.m.
13.—COKE SALESMEN'S CIRCLE.—Meeting at 28, Grosvenor Gardens, 2.30 p.m. Paper by Mr. S. C. Fox, of Tottenham.
14.—B.C.G.A.—Midland District Meeting, Birmingham.
15.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting and paper by Mr. P. F. Scarth.
16.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION. Meeting at Port Talbot. Paper by Mr. West.
16.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Barnsley. Papers by Messrs. V. J. J. Siddons, R. H. McCulloch, and A. Pickard.
21.—B.C.G.A.—South Wales District Meeting at Cardiff.

Gas Floodlights Leamington Spa Pump Room

The accompanying photograph (by the *Leamington Spa Courier*) shows the gas floodlighting of the Pump Room by the Leamington Priors Gas Company. Seven Parkinson 10-mantle alignment lamps are used for lighting the upper fascia of the building, while one Sugg 10-mantle parabolic lamp lights the 35-ft. tower. Favourable comment was made on the lighting at the last Town Council Meeting, when it was suggested that similar treatment of other public buildings and gardens might be taken into consideration in connection with the celebrations of the Silver Jubilee of His Majesty the King's reign. It is also, incidentally, the Diamond Jubilee year of Leamington's incorporation and the Centenary of the Municipal Corporations Act. We hope the Leamington Gas Company will have the opportunity of playing a further part in the celebrations.

PERSONAL

Major GEOFFREY H. KITSON has been elected Chairman of the Coal Gas and Fuel Industries (Livesey Professorship) Committee in succession to the late Dr. C. F. Tetley.

* * *

Mr. W. NICOL BAIRD, B.Sc., who has been appointed Assistant Engineer and Manager of the Dunfermline Corporation Gas Department, was trained in the Granton Gas-Works of the Edinburgh Corporation where he served for five years. During that period he attended the Heriot-Watt College, gaining first-class Higher Grade Certificates in Gas Engineering and Gas Supply. Mr. Baird later vacated his position to pursue a course of study at Edinburgh University where he graduated B.Sc., with first-class Honours in Engineering. Thereafter he was again engaged at Granton for a short time, and in May, 1934, was appointed to the Staff of the Fuel Research Station, London.

* * *

Mr. J. H. TROUGHTON, J.P., who resigned the post of Manager of the Newmarket Gas Company at the end of 1934, but is still Chairman of the Directors—an office in which he succeeded the late Mr. Robt. Stephenson—entertained the Company's staff at dinner in the lecture room at the Company's showrooms at the old Town Hall on Wednesday, Jan. 16.

* * *

Mr. W. BOLTON, who has been Manager of the Thorne Works of the South Yorkshire and Derbyshire Gas Company for the past 15 years, was recently presented with a handsome Westminster chiming clock by the employees of the Company on his departure to take up a new managerial post at the St. Neots (Hunts.) Gas and Coke Company, Ltd. He will be succeeded by Mr. F. STANIFORTH, who for the past four years has been Manager at the Whitwell Station.

* * *

Mr. E. WATTY, of Torpoint, has been appointed to succeed Mr. T. M. HALEY as Works Manager of the Torpoint Coal and Gas Company, Ltd. Mr. Haley has received an appointment in South Africa.

* * *

Mr. CYRIL MURTON CROFT, Chief Engineer and General Manager to the Wandsworth and District Gas Company, has been elected a Member of the Institution of Civil Engineers.

* * *

Mr. ALAN NICHOLSON, at present Technical Assistant to the Darlington Gas Department, has been appointed Assistant Manager to Bingley (Yorkshire) Urban District Council Gas Undertaking, in succession to Mr. JOHN ROBERTS, newly appointed as Engineer and Manager at Ripon.

* * *

Tributes to Mr. J. WARRILLOW, the Gas-Works Manager, who recently completed 50 years' service, were paid at the fourth Annual Dinner at the Town Hall, Stoke, on Jan. 15, of the Stoke-on-Trent Gas Department, when he was the recipient of a presentation from the staff and employees, and also a gold long service medal.

* * *

Mr. WILLIAM CHRISTIE CAMPBELL, Assistant Gas Engineer, of Helensburgh, was married in St. Andrew's Church of Scotland, Falkirk, on Jan. 16, to Miss Ada M. C. Blackadder, of Falkirk.

OBITUARY

His many friends in the Industry will learn with regret of the recent death of Mr. ARCHIBALD CADDICK, who was for a period of 28 years in the service of the Croydon Gas Company. For half this time he was assistant to the late Mr. J. W. Helps and for the other half he was Chief Engineer to the Company. Mr. Caddick, who retired in May, 1927, witnessed an enormous growth in the Croydon Company's business, and was in a large measure responsible for the considerable enlargement of the Waddon Works.

* * *

The death occurred on Jan. 15 of Mr. C. H. COLLINS, District Superintendent to the Swansea Gas Light Company. The Wales and Monmouthshire Junior Gas Association have lost an old friend in Mr. Collins, who, besides being a Past-President and a member of the Council, was one of the Association's founder members.

* * *

Mr. JOHN MACKENZIE, former Senior Representative for Messrs. Sawer & Purves, Nelson Meter Works, Miles Platting, Manchester, passed away at his residence, Southbourne, Bournemouth, on Jan. 15. Mr. Mackenzie had been associated with Sawer & Purves for over 45 years, and his loss will be deeply felt by all his associates with whom he was extremely popular.

CORRESPONDENCE

The Open Coke Fire

SIR,—In the reference made to my recent paper to the Institution of Heating and Ventilating Engineers, in the Editorial Notes of your current issue, you question my statement that the open coke fire is suitable for supplementing heating installations installed to give only a 25° temperature rise, and feel that this use of the open coke grate "is too small to encourage anyone to cater for it, since the capital invested in the provision of grates for the purpose is lying idle for 50 weeks of the year."

With the greatest respect, I should like to point out that the period of use of the grates would not be thus limited, for assuming that it is necessary to maintain rooms at a temperature of 65°, the central heating installation would, theoretically, need to be supplemented whenever the outside temperature fell below 40°. The average temperature in London for the seven winter months is between 42° and 43°, and the periods at which it is below 40° are extensive. In actual practice the type of central heating installation referred to is not usually used to maintain temperatures higher than 60°, and supplementary heat such as that obtained with the coke grate will be called for daily throughout the greater part of five months through the winter.

Yours, &c.,
L. J. FOWLER,
Technical Adviser.

London and Counties Coke Association,
9, Grosvenor Gardens, S.W. 1,
Jan. 18, 1935.

The Combustion of Coke

SIR,—I have been reading Mr. L. J. Fowler's contribution, "GAS JOURNAL," Jan. 9, 1935, and have been struck by the somewhat vague nature of his pronouncement near the beginning: "Item 1.—With coke no abnormal draught conditions are necessary." With due respect may I suggest that this remark is somewhat meaningless unless accompanied by a definition of what the author implies by "abnormal."

The question of coke combustion has interested me for many years, and I ventured to express some views in a paper read at Newcastle in 1926 (J.Soc. Chem. Ind., Jan. 14, 1927, pp. 1T-20T), from which I beg leave to quote a paragraph:

> "The lower the combustibility of a coke the more intense is the draught required to burn it. The reason probably is that a greater scouring effect is necessary to sweep away the film of carbon dioxide that forms on the surface. With highly combustible coke it is possible that a self-scouring effect takes place by virtue of a kind of breathing action that occurs in the surface pores of the fuel. The combustion would seem to penetrate slightly below the surface in a periodic manner, and a continuous passage of products of reaction inwards and outwards to the surface would take place, resulting in repeated breaking of the surface film of carbon dioxide, and allowing further contact with air. A fuel devoid of a finely porous surface would not allow this type of combustion."

I think that this "breathing" characteristic of solid

fuel combustion merits more investigation than it has received. Personal observation of a brightly glowing fire will reveal a periodicity in the brightness of the glow which is indicative of some periodic change in the combustion occurring in the region of the surface pores. A similar periodicity of much longer interval was observed in the course of an investigation in which the writer was privileged to take part with Mr. Edgar C. Evans in 1913 underground, when a portion of the Senghenydd pit which was on fire after the great explosion was isolated by sand bashings. The results were incorporated in a paper read subsequently by Mr. Evans before the Colliery Officials' Association.

Yours, &c.,
LAURENCE H. SENSICLE.

Eccentric Club,
Ryder Street, S.W. 1,
Jan. 21, 1935.

News In Brief

Subject to Loan Sanction, the Walsall Corporation Gas Department's mains are to be extended to include the Aldridge Urban District, at a cost of £1,912.

The Cupar Gas Company has contributed £10 towards the fund for providing a new ambulance for the Cupar and District Ambulance Association.

An Exhibition of Modern Gas Appliances is being held by the Polmont District Gas Company from Jan. 22 to 25, inclusive, in the model travelling showroom of Messrs. R. & A. Main, Ltd. Cookery demonstrations are being given twice daily.

Applications are Invited by the Smethwick Gas Department for the position of Distribution Superintendent at a salary of £400 per annum. The same Undertaking also requires the services of a Lady Demonstrator, to whom they are offering a commencing salary of £200.

Gas-Driven Vehicles in Poland.—It is reported that experiments are being made in Warsaw with the running of the engines of motor 'buses on "bottled gas." It is stated that the local Gas Undertaking are prepared to supply gas in cylinders at a pressure of 200 atmospheres.

To Celebrate the Jubilee of the taking over of Kilsyth Gas-Works as a municipal concern, the Town Council on Jan. 14 decided to give all Burgh employees a day's pay and to distribute a quantity of coke among the poor. It was also agreed to inaugurate a system of floodlighting as part of the celebrations.

The Inaugural Dinner of the Association of Silk Screen Printers and Display Producers was held at the First Avenue Restaurant, High Holborn, W.C. 1, on Friday, Jan. 18. Over eighty members and guests were present to hear Mr. W. R. Oliver, Display Officer to the B.C.G.A., give an address on "Display in Industry."

A New Battery of 52 coke ovens is to be built by Messrs. Strakers & Love at their Brancepeth Colliery, Durham, adjoining their present plant. This extension is rendered necessary as a result of an arrangement the firm have made to supply Darlington with coke oven gas. A distance of 16 miles separates the colliery and Darlington.

Bo'ness Gas Exhibition.—An exhibition of gas apparatus—the first of its kind in Bo'ness—was opened officially on Jan. 14 by ex-Provost Simpson, Chairman of the Bo'ness Gas Light Company, Ltd. Cookery demonstrations were held all the week and were excellently attended. The exhibition was arranged in conjunction with Messrs. R. & A. Main, Ltd.

The Crown of one of the gasholders of the Stone Gas Light and Coke Company, Ltd., is now being used for advertising purposes. The Manager of the Company, Mr. J. R. Heath, who was kind enough to forward us an aerial view of the advertisement, wonders if it is the first trade advertisement to be painted on the crown of a gasholder in this country.

Radio Listeners will again have an opportunity of hearing the Newbridge Male Voice Choir (comprising employees of the Horstmann Gear Company, Ltd.) on Feb. 21, 1935, on the occasion of their 8th Annual Concert. This concert is to held at the Pump Room, Bath, and will be relayed from 9.15 to 10 p.m. on the West Regional Programme.

One Hundred and Eighty Children between the ages of five and thirteen were entertained on Jan. 12 at the St. Luke's Church Hall, Bromley, by the Bromley Gas-Works Social Club of the South Suburban Gas Company. This function, which has become an institution in the Club now, was made possible by the voluntary subscriptions of members, together with a grant from the Board of Directors. A varied entertainment was provided for the youngsters, a record number of whom were present; and various Officials of the Company, including Mr. Simmonds and Mr. Gould, visited the party.

Sanction for a Loan of £5,000 for the renewal of plant at their Gas-Works has been received by the Omagh (Co. Tyrone) Urban District Council from the Northern Government. A sworn inquiry was considered unnecessary on account of the satisfactory manner in which the Works are being managed and the Ministry acted solely on the report of their inspector.

Largs Continues to Use More Gas, despite the introduction of electricity into the town some time ago. For December the make was 4,488,000 c.ft., compared with 4,450,000 c.ft. for December, 1933—an increase of 38,000 c.ft.—while from April 15 to Dec. 31 the make was 40,087,500 c.ft.—an increase over the corresponding period in 1933 of 1,235,300 c.ft.

The Second Burns Dinner of the Greenock Corporation Gas Department Men's Social Club was held on Friday, Jan. 11. The President, Mr. Gavin L. Smith, presided over a large gathering. He was supported by Bailie Harry Lyall, Gas Convener; Mr. Ronald D. Keillor, Gas Manager; Mr. Norman Sturrock, Assistant Manager; Mr. J. Reffell and Mr. John Donald.

A Musical Broadcast at Christmas from the Royal Nederlands Motor Liner "Colombia" at Barbados was compèred by Mr. J. W. Brown, of the Barbados Gas Company. The programme consisted of English, Irish, French, and Norwegian carols and attracted quite a deal of attention in the *Barbados Advocate*, who devoted two columns to a detailed account of the programme.

Price Reductions are announced by the Polmont District Gas Company for all consumers, domestic and industrial. The charge will be 5s. per 1,000 c.ft. up to 5,000 c.ft. per quarter, quantities in excess of that figure being charged on a reduced scale, sliding from 4s. 7d. to 3s. 4d. per 1,000 c.ft. Slot meter consumers will be charged according to the scale, plus 5d. per 1,000 c.ft.

Co-operative Publicity.—The Bradford Corporation Gas Department are one of the local trade undertakings co-operating with the New Victoria Cinema and a local newspaper in a joint publicity campaign during this week. The firms concerned have staged an attractive display of their goods in the extensive waiting lobby of Bradford's biggest cinema, which is transformed into a kind of miniature home. Lighting fittings of the latest types, cookers, and fires in colour enamel are outstanding features of the show. Water heaters and other equipment are also on display.

GAS LEGISLATION

A Summary of the Position at the end of 1934

By George Evetts, M.Inst.C.E., M.Inst.Gas E., M.Inst.Cons.E.

The striking articles which Mr. Evetts contributed to the "JOURNAL" at the end of last year are now available in the form of a handy book, in similar style to the very popular annual "Technical Signpost" to the "JOURNAL." A general index and marginal annotations make reference easy, and from the many inquiries received while the articles were running, we believe the publication will find a very general welcome from Boards of Directors, Company Secretaries, Municipal Officers, and in many other quarters.

From the "JOURNAL" Office—
pp. 51, bound in cloth, 3s. 6d. net, postage 3d.
Six copies and over, post free.

A Special Order is being sought by the Sheffield Gas Company to authorize them to acquire by agreement and to hold certain lands for the manufacture and storage of gas and the treatment of residuals. The Company also seeks powers to incorporate with the Order, with or without modifications, or to render inapplicable to the Company all or some of the provisions of the Lands Clauses Acts.

Production of Coke at Rochdale.—Mr. Francis H. King, of the Rochdale Corporation Gas Department, who is an Associate Member of the Institution of Gas Engineers, in an Address at Rochdale mentioned that experimental work was being carried on at the Rochdale Gas-Works in order to produce a coke which would meet more completely every domestic requirement, including greater ignitability.

That Gas-Works' Extensions at home and abroad are occupying Manchester firms was stated in the Annual Report of the Engineering Committee of the Manchester Chamber of Commerce, and some of them are of considerable magnitude. Some definite inquiries are also in hand for future work, and the position generally has considerably improved by comparison with that of twelve months ago.

The Import Duties Advisory Committee give notice that they have under consideration applications for an increase in the import duties on:—Iron and steel (including alloy steel) of the following descriptions: Blooms, billets, slabs, and sheet and tinplate bars (other than of wrought iron produced by puddling with charcoal from pig-iron smelted wholly with charcoal); iron and steel rails weighing less than 36 lbs. per yard.

The Showrooms of the Birkenhead Corporation Gas Department in Argyle Street have been re-decorated and re-organized. The windows of the showrooms have been altered, and have been floodlighted by gas. Ten thousand enamelled gas stoves have been supplied by the Corporation in three years. The Gas Department has arranged an exhibition at St. Anne's Parish Hall, St. Anne Street, at which cookery and washing demonstrations will be given.

Price Reduction.—Withnell Urban Council have reduced the price of gas from 3s. 6d. to 3s. 3d. per 1,000 c.ft. The Chairman (Mr. E. Saunders) said since 1926 they had reduced the price from 5s. by five reductions of 3d. and one of 6d. The credit for this was due to the management. A reduction of 1d. per 1,000 c.ft. meant a reduction of £80 in the income-tax. By this means they had saved £1,680 since 1926, and this saving is being returned to consumers.

Home Service in Dublin.—The Alliance and Dublin Gas Consumers' Company has inaugurated a new home service by a series of lectures in their newly-erected theatre in D'Olier Street, claimed to be one of the most modern in the British Isles. Here a kitchen has been equipped, and also a tea room, where the housewife can learn the most up-to-date method of gas cooking. The lectures which are given daily cover cookery, water heating, laundry work, and refrigeration.

A Programme of Extensions is being carried out by the Swindon United Gas Company. The Board of Trade has recently issued a Special Order authorizing them to extend their mains to supply many surrounding villages. This will necessitate the laying of an additional 37 miles of mains. Last year the Company increased their output by 14 million c.ft. The reconstruction of the carbonizing plant and the erection of new coke screening and grading plant is now well advanced, and the work is expected to be completed by June.

A Highly Attractive Stand at a Grocers' and Allied Trades Exhibition being staged from Jan. 16 to 26, at Fentin Street Drill Hall, Leeds, has been organized by the Leeds Gas Department. Lighting equipment, cookers, fires, water heating appliances, and refrigerators are on view, and, in some cases, in operation. Several other exhibitors are using gas appliances supplied by the Gas Department for cookery and other demonstration purposes. The Department's own stand is making a special feature of refrigerators for shopkeepers supplying food.

"A Gasholder Explosion."—Our readers may have noticed a few days ago an alarming paragraph in the daily Press to the effect that "a gasholder containing 300,000 to 400,000 c.ft. of gas blew up at Barrow on Jan. 17." Mr. C. Diamond, the Barrow Gas Engineer and Manager, tells us, however, that there was no explosion. Gas from the holder ignited, and, apart from damage to half the crown, there were no other serious consequences. The only personal injury was to a man standing in the street, who was burned about the neck and arms.

The Gas Industry in Czecho-Slovakia.—67 of the 85 Gas Undertakings in Czecho-Slovakia are owned by municipal and local authorities and eighteen by private companies. The largest works are those of the Prague municipality, which are responsible for 43% of the country's gas production. Of the total, 51 works are in Bohemia, 27 in Moravia and Silesia, and 7 in Slovakia. An analysis shows that apart from those in Prague, the majority of the Czecho-Slovakian gas-works are of a relatively small character. Seven have an annual output of less than 3,530,000 c.ft., forty-three have outputs ranging between 3,530,000 and 17,650,000 c.ft.; eighteen between 17,650,000 and 35,300,000 c.ft.; fourteen between 35,300,000 and 176,500,000 c.ft.; and only three over 176,500,000 c.ft. The length of the gas mains in the country is estimated at about 2,000 miles.

Amalgamation and Grouping.

Further South-Western Corporation Acquisition.

The South-Western Gas Corporation have recently acquired the Ottery St. Mary Gas Undertaking, while, in addition, the offers recently made to the shareholders of the Midsomer Norton Gas and Coke Company and the Crewkerne Gas and Coke Company have resulted in the acquisition by the Corporation of a substantial majority of the shares of both Companies.

Severn Valley, Stourport, and Brinscombe and Chalford.

The Severn Valley Gas Corporation announce that the recent offers made to the Stourport Gas Company and the Brimscombe and Chalford Gas Light and Coke Company, Ltd., have been accepted by a substantial majority of the shareholders of both companies.

Sir Francis Goodenough's Australian Paper.

We regret that we were incorrectly informed concerning the Paper, "Essential Factors in the Promotion of Gas Sales," by Sir Francis Goodenough, C.B.E., which was reported in the "JOURNAL" for Nov. 14, 21, and 28. The Paper should have been referred to as being presented to the Victorian Gas Industry during the recent Victorian Centenary Celebrations, and not to the Colonial Gas Association Centenary Conference as stated in the "JOURNAL." The Colonial Gas Association has, of course, not yet attained its centenary.

Report of the Livesey Professor at Leeds.

Prof. J. W. Cobb, C.B.E., B.Sc., F.I.C., Livesey Professor at the University of Leeds, has submitted his report for the session 1933-34 to the Chairman and members of the Livesey Advisory Committee on the work of the Department of Coal Gas and Fuel Industries (with Metallurgy).

The session under review shows a falling off in the number of students in the Department from 31 to 22. This is not due to reduction in the number of entries, but rather to the movement of senior students into outside employment.

The analysis of the number of students in the Department may be stated thus:

—	1932-33.	1933-34.	1934-35.
1st year B.Sc. Course	5	6	5
2nd ,, ,, ,,	5	7	6
3rd and 4th years B.Sc. Course	18	10	9
Post graduate degree students	5	6	1
,, ,, diploma ,,	1	..	..
,, ,, research ,,	..	1	½ 1
Industrial research students	1	..	..
Occasional students	1	..	..
	36	30	22

In addition to these students specially attached to the Department, courses in Fuel and Metallurgy are attended by students of Chemistry, Engineering, and Mining, and lectures on Steam Raising by students of Colour Chemistry, Leather Industries, and Textiles.

No substantial change has been made in the curriculum for the degree or diploma in Gas Engineering or in Fuel and Metallurgy, and the day courses have been given under the same titles as in past years, but the content of each course, it should be pointed out, is modified from time to time. The study of heat transfer and insulation, illumination, furnaces, and gas utilization generally, may be mentioned as subjects which are receiving increased attention.

Co-operation between the Institution of Gas Engineers

and the University continues to be effected through the Joint Research Committee, with Mr. T. Hardie, Chief Engineer of the Gas Light and Coke Company, as Chairman.

The thanks of the Committee are due to the Leeds Corporation Gas Department and its Manager, Mr. C. S. Shapley, for the provision of laboratory accommodation and gas supply in this connection.

Scholarships.

The Cartwright Holmes Scholarship is now held by R. G. Parker from the Plymouth and Stonehouse Gas Company, and the Corbet Woodall Scholarship by J. Castle, from the Brighouse Corporation Gas Department. Both scholars are studying for the B.Sc. degree in Gas Engineering.

Appointments of old students during the period under review:

T. H. Blakeley, Ph.D.	South Yorkshire Chemical Works, Parkgate, Rotherham.
H. D. Brook, B.Sc.	Newton Chambers & Co., Ltd., Thorncliffe, Sheffield.
A. Gillies, B.Sc.	Grassmoor Colliery Company (Coke Ovens), Chesterfield.
E. I. Lloyd, Ph.D	Imperial Chemical Industries, Ltd.
I. J. Lane, M.Sc.	Bournemouth Gas and Water Company.
G. Milner, Ph.D.	South Yorkshire Chemical Works, Parkgate, Rotherham.
D. Sismey, B.Sc.	T. Teisen, Furnace Constructor, Birmingham.
N. B. Sands, B.Sc.	Guernsey Brewery Company.
R. C. Taylor, B.Sc., M.I.Mech.E.	Engineer and Manager, Torquay and Paignton Gas Company.
F. C. Ferguson, B.Sc.	Malta and Mediterranean Gas Company.
M. H. Wheeler, B Sc.	Unilevers, Ltd
N. R. Balmford, B.Sc.	Fletcher Russell & Co.
T. G. Spalding, B.A.	Gas Light and Coke Company, London.
T. Stamper, B.Sc.	,, ,, ,, ,,
K. Higginson, B.Sc.	Leeds Corporation Gas Department.
I. W. Raine, B.Sc.	,, ,, ,, ,,
E. Spivey, Ph.D.	Research Chemist, Gas Light and Coke Company, London.
G. E. Holmes, B.Sc.	Newcastle and Gateshead Gas Company, Industrial Sales Section.
H Millner, B.Sc.	Scarborough Gas Company.
K. Sheard, B.Sc	Weston-super-Mare Gas Company.
A. C. Bureau, B.Sc.	W. C. Holmes & Co., Ltd., Huddersfield.
G. B. Howarth, M.Sc., A.I.C.	Director of Fuel Research, New South Wales.
F. Bell, B.Sc.	Industrial Sales Department, Liverpool Gas Company.
G. E. Hall, M.Sc.	Simon Carves, Ltd., Stockport.

GRADUATES.

Ph.D., 1934	T. H. Blakeley. B. P. Ghosh. G. Milner.
M.Sc.	I. J. Lane. R. Daily. F. W. Branson.
B.Sc., Honours—	
1st Class	G. E. Holmes. N. R. Balmford.
2nd Class	G. E. Hall.
B.Sc., Ordinary	K. Higginson. T. Stamper. D. G. Woolfenden. J. E. Cullingworth.

Glass Silk Insulation.

Practical Applications.

The use of glass silk as an insulating medium was referred to in the course of the discussion on Messrs. Windiate's and Craddock's paper before the Manchester District Association last October. The subject was further dealt with at a joint meeting of the Glasgow Sections of the Society of Chemical Industry and the Institute of Chemistry held in the Royal Technical College, Glasgow, on Jan. 18. Two papers were read by members of the staff of Chance Brothers & Co., Ltd. Dr. Hampton dealt with "Physical Properties of Glass," and Mr. Boyd took as his subject "Glass Silk and Heat and Sound Insulation."

Mr. Boyd said that the problem of heat insulation had received considerable attention in recent times and its importance was being more appreciated nowadays. The choice of insulating materials was formerly limited to cork, mud, clay, and mixtures of these with straw. More recently asbestos and magnesium carbonate mixtures had been developed with considerable advancement. Mixtures containing magnesium carbonate, however, tend to decompose at temperatures in the region of 500° C. with partial or complete disintegration. During the war there was an asbestos shortage in Germany, and spun silk was introduced as an insulating material. The manufacture of this product was commenced in 1930 by Chance Brothers & Co., Ltd., at their Firhill Works, Glasgow, and it will be of interest to the Gas Industry to hear of the success of this venture.

By means of slides, Mr. Boyd illustrated the uses of glass silk for insulating bitumen tanks, pipe lines, and ducts, and he showed a Lancashire boiler on which the entire front had been lagged, resulting in considerable fuel economy as well as producing more comfortable conditions for the operators.

The glass silk is made in the form of large mattresses for covering extensive areas and in strips for small diameter pipes. It has a low specific gravity, stands up to high temperatures, resists severe vibrations, and its thermal conductivity at a mean insulation temperature of 55° F. is 0·27 B.Th.U. per sq. ft. per hour for 1 in. thickness and 1° F. difference in temperature. Glass silk has also been used for sound insulation and for air filtration. This latter application has been widely developed in America.

Mr. Boyd made the interesting suggestion to gas engineers that a small filter of glass silk should be fitted on gas lines just before they enter the meters to prevent the minute traces of tar, &c., entering the leather diaphragm.

Institute of Fuel.

Discussion on Therm Costs.

An Informal Meeting of the Institute will be held on Friday, Jan. 25 (6.30 for 7 p.m.) at British Industries House, Oxford Street, W. 1, when a discussion will be opened on the subject of "The Cost of Production, Transport, and Distribution per Therm of Various Fuels, relative to the Prices paid by Users." Mr. Stephen Lacey (Gas Light and Coke Company) will deal with gas and coke, Mr. C. Dalley (British Controlled Oilfields) with oil, and Mr. J. Stanleigh Turner (Moira Colliery Company) with coal.

Gas Cookers in Schools.

The provision of gas cookers in schools was discussed at a meeting of the Cardiff City Council on Tuesday, Jan. 15. Mr. G. Baden Smith moved the reference back of a minute of the Education Committee that new gas cookers be installed in various domestic science centres in Cardiff. They had an Electricity Department in Cardiff; they should install electric cookers so that the present generation could have a knowledge of those appliances. The objection of the parents to purchasing electric cookers was because nobody in the house understood them. If the children were trained in their use that objection might be disposed of.

Alderman G. Fred Evans remarked that the quarterly charge for gas cookers was to be only £6 10s., as against £6 19s. 6d. for the electric. Mr. G. E. B. Frewer said it seemed to be unfair that there was so much said in favour of electricity because the Corporation owned the Electricity Department. They had to remember that the Cardiff Gas Company was a big undertaking, paying big rates, and they were model employers.

The reference back was defeated and the minute carried.

Stoke-on-Trent Goes Ahead.

Tributes to Mr. A. Mackay.

At the annual dinner of the City of Stoke-on-Trent Gas Department many deserved compliments were paid to the Chief Engineer and General Manager for his able management of the Undertaking.

Mr. J. Johnson, submitting the toast, "Those We Serve," said: Our service covers a wide area. We have more than 300 miles of mains, with hundreds more miles of service pipes to supply the homes, factories, business premises, hospitals, and various institutions. We have more than 67,000 registered consumers, and it is pleasing to note that last year brought 1,750 new consumers.

Mr. Johnson said many people must have welcomed the introduction of the hire-purchase system. The Department had sold 21,226 gas cookers and 10,182 gas fires and boilers, while they had also sent out 19,342 gas cookers on the ordinary hire system. All this (he proceeded) necessitates increasing the output. Our central Works at Etruria have met the demand and have produced and sent out in one day 7,221,000 c.ft. of gas.

Replying to the toast, the Lord Mayor of Stoke, Alderman A. C. Harvey, said that the improvements and extensions of recent years had been fine achievements, and to Mr. Mackay they extended their hearty thanks for the way he had brought them to such a successful issue. They were proud of him; his advice to the Corporation, through the Gas Committee, was invaluable, and when they had followed it, they had always come out well.

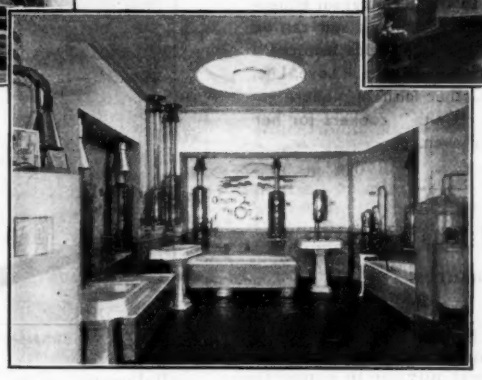
FINE GAS DISPLAY AT MELBOURNE EXHIBITION

The accompanying photographs show a number of the very fine displays arranged by the Gas Industry of Victoria at the Centenary All-Australian Exhibition at Melbourne in October-November last.

Above.—General View of the Gas Stand.

Left.—Large-Scale Cooking Display.

Above.—The attractively set out Rest Room, with the Gas Fire Display beyond.



Above.—The Industrial Heating Exhibit.

Left.—The Gas Water Heating Display.

Westminster Technical Institute.

Annual Prize Distribution.

By kind permission of the Gas Light and Coke Company, the Annual Prize Distribution of the Westminster Technical Institute took place on Tuesday, Jan. 15, at the Horseferry Hall, S.W. 1. Nearly 500 were present when Sir Francis Goodenough, C.B.E., took the chair. Among those supporting the Chairman were Mr. Alan E. L. Chorlton, C.B.E., M.P., M.Inst.C.E., Past President of the Institution of Mechanical Engineers, His Worship the Mayor of Westminster, Mr. F. G. Rudler, F.S.I., Mr. Stephen Lacey, B.Sc., M.Inst.C.E., Junior Vice-President of the Institution of Gas Engineers, Mr. W. L. Galbraith, Secretary to the Gas Light and Coke Company, and Dr. J. N. Long, Principal of the Westminster Technical Institute.

In the course of his remarks, Dr. Long stated that at the College there were 1,015 students qualifying for positions in the Gas Industry. In the Institution of Gas Engineers' Examinations in Gas Engineering and Gas Supply held this year, out of the 100 students trained by the Institute, 78 were successful. The number of entries from the College represented 53% of the total for the country. Dr. Long went on to thank the Gas Light and Coke Company for all that they had done for them at the Technical Institute, and welcomed Mr. Alan Chorlton and the Mayor of Westminster who, added the Principal, was hardly a stranger since he was kind enough to have taken the chair at the last gathering in the absence of Sir Francis.

The prizes and certificates were then distributed by Mr. Alan Chorlton who, later, gave an interesting address, illustrated by lantern slides, entitled "The Age of Speed." This was a retrospective survey of the application of the high-pressure internal combustion engine to aircraft and locomotion.

A vote of thanks to Mr. Alan Chorlton was proposed by the Mayor of Westminster and seconded by Mr. Stephen Lacey. The Gas Light and Coke Company were thanked for their kind hospitality by Mr. J. E. Montgomery, B.Sc., M.I.Mech.E., who was seconded by Major A. J. Martin, M.Inst.C.E., F.G.S. Mr. W. L. Galbraith briefly replied on behalf of the Gas Light and Coke Company, and the proceedings terminated with refreshments provided by the Company.

Lectures on Inventions.

Members of the Institution of Gas Engineers are invited to attend the forthcoming meetings of the Institute of Patentees at 10, Victoria Street, London, S.W. 1.

Wednesday, Feb. 20.

Lecturer: Mr. H. W. Dickinson, M.I.Mech.E.
Subject: "Many Inventions."

Wednesday, March 13.

Lecturer: Mr. A. P. Thurston, D.Sc., M.I.Mech.E., F.R.Ae.S.
Subject: "The Commercial Development of Inventions."

Gracie Fields Cooks by Gas.

This display, which was designed by the Parkinson Stove Company, and arranged in conjunction with the City of Birmingham Gas Department, created considerable public interest, being featured during the visit of Miss Gracie Fields to the Birmingham Hippodrome. This progressive link-up with the famous star can be appreciated all the more by the fact that Miss Fields featured a Parkinson "Minette" gas cooker in her popular film "Love, Life, and Laughter," and has since placed further faith in modern gas appliances by selecting two Parkinson "Unita" cookers for her Orphanage at Peacehaven.

Scottish Regional Gas Grid.

Proposed Measures.

Sir Arthur Rose, Commissioner for the Distressed Areas of Scotland, has appointed Mr. Birkett Wylam, M.Sc., Ph.D., Chief Inspector for Scotland under the Alkali, &c., Works Regulation Act, as his expert adviser in connection with proposals which are under consideration as to the possibility of establishing a regional gas grid within the industrial area of Lanarkshire and Renfrewshire.

The announcement by Sir Arthur Rose that he has under consideration a regional gas grid is a natural sequel to the findings contained in his report on the conditions in the distressed areas in Scotland, which was submitted to Parliament last November.

In that report Sir Arthur stressed the interdependence of the basic industries of Lanarkshire and the Clyde, which made the district one economic unit sharing prosperity and depression.

The Scottish pig iron industry, he stated, was experiencing special difficulties because it was unable to compete with the Continent and England, where furnaces were more modern; and under the heading of remedial measures he referred to the Baird gas offer, which arose from an effort by Messrs. William Baird to modernize their coke ovens at Coatbridge, and so compete in the pig iron market against outsiders.

Glasgow Corporation was the only gas undertaking in the West of Scotland sufficiently large to absorb the gas from the proposed plant, for within the remainder of Lanarkshire demand fell short in the summer months by 30%. Glasgow rejected the offer.

According to the report, the price offered for a daily supply of some six million c.ft. was below the cost of production to the Corporation, and on that basis represented a saving of 10s. a ton in the ultimate price of pig iron.

A contract of such a nature would involve a capital outlay of about £500,000, and an undertaking by the firm in question to maintain this supply of gas over a period of years without reference to their sales of this large quantity of pig iron, and at a fixed price, regardless of any increase in the cost of raising coal. This, Sir Arthur stated, was a very big responsibility.

Messrs. William Dixon are planning to modernize their coke ovens at Polmadie. When the new ovens are in working order approximately 9 million c.ft. of gas will be extracted. Some of this will be used in the works, but there will be a surplus of 5 million c.ft., which, at present, cannot be marketed.

A Cooker on "American" Lines.

Parkinson Stove Company's New Model.

Not long ago in the "JOURNAL" an eminent American gas man wrote: "In one of your leading research and testing laboratories I heard the merits of a British gas cooker extolled to the skies. It had about as much 'sex appeal' as an iceberg. Standing alongside it was an American gas range, not so sturdily built admittedly, but in attractive coloured porcelain enamel, not a bolt or nut showing, and designed to appeal to the inherent artistry of a house-proud woman. The one a battleship, the other a graceful yacht, if you please."

Opinions may differ, but we have on occasions heard a demand expressed by gas salesmen for a cooker conforming more in general design with the type in use on the other side of the Atlantic — several were illustrated in the "GAS SALESMAN" for October last. Moreover, this is a design which is commonly produced by the electrical industry in this country. We were therefore particularly interested to notice in a small model kitchen at the Royal Academy Exhibition of British Art in Industry, now open at Burlington House, London, a gas cooker of this type which has been designed by the Parkinson Stove Company, in collaboration with Mrs. Darcy Braddell. As our illustration shows, it has many novel features.

The chief point, perhaps, is the claim that this cooker is the only one which has been definitely designed so that it may be built in, if required, flush with other kitchen equipment. Its total height is only 34 in., which is the generally recognized height for tables, sinks, &c. It will also be observed that there is no piping to be seen, nor any crevices to harbour dust or grease. The hotplate is of the solid variety, with four normal type burners and one high-speed boiling burner. The taps are all inset along the front of the cornice.

Below the hotplate is an enclosed grilling chamber, with drop pattern door, behind which is a hot closet. The oven also has drop door which provides a convenient shelf for resting dishes. The oven is automatically operated from the control seen just above the door in the accompanying photograph, while it is equipped with two burners and bottom flue outlet.

Another point of interest is that all the burners are self-lighting on the electric filament principle, though experiments have not yet been concluded in respect of the type of lighter which will be finally adopted. There may, indeed, be several other minor developments before the apparatus is finally ready for general marketing.

The cooker is in white enamel finish with black taps and door handles, and the whole makes a very striking and pleasing appliance, which, it is understood, will probably be in production by the beginning of April.

A Business Man's View of Education for Commerce and Industry

On Jan. 5, Sir Francis Goodenough, C.B.E., Chairman of the British Association for Commercial and Industrial Education, addressed the Conference of Schoolmasters and College Tutors at Cambridge; and below we publish an abstract of his remarks.

by

SIR FRANCIS GOODENOUGH

Before a business man gives his view of Education for Commerce and Industry it is perhaps as well that he should state his view of business itself—that is the word that I think best covers the whole field of production and marketing which is implied by the words Industry and Commerce—so that he may make clear what he considers to be the qualifications which education should help anyone to possess who intends to take up commerce or industry, or both of them (or to cover both of them let us continue to say "Business") as a career.

A Committee of which I had the responsibility and honour to be Chairman spent much time between 1928 and 1931 in studying the subject of education for salesmanship. A quotation from the first Interim Report of that Committee, published in 1929, will make it clear that their inquiry covered much of the subject of this Address, so that reference to it may be useful and lead up to a statement of my conception of business.

Dealing with the nature and scope of their inquiry, the Committee said: "Salesmanship, as we understand it, is a prime function of direction and supreme management; not merely of sales management. It embraces the study of the fundamental principles of commerce and the planning of policy based upon them, as well as the selection, training, and direction of the personnel required for translating policy effectively into action. Salesmanship is the basis of all commerce, the first and last object of which is to market goods or services to the mutual profit and lasting satisfaction of buyer and seller. Education for salesmanship is therefore education for commerce on its creative, organizing, and executive sides; and, in Lord Eustace Percy's words, 'covers the whole field of higher education.'"

Let me here make it clear that by education for commerce the Committee did not merely mean the teaching of shorthand, typewriting, accountancy, secretarial work, office methods, and so forth—which are indeed only dealt with at all as ancillary subjects. Knowledge of those subjects is very useful; possession of it by certain members of staff is indeed essential to the efficient transaction of business; but the most complete knowledge of all of them does not qualify anyone to transact business efficiently—that is, to achieve skilfully the prime purpose of business, namely, the selling of goods or services.

What is Meant by "Business?"

At one time, we often heard the expression: "Business is Business;" and that sounds an obvious platitude, at first thought an harmless one. But it is far from that because, in its implications and applications, that cynical maxim has proved an excuse for a deplorable disregard of truth, honesty, and humanity in business, for a demoralizing and entirely false distinction between honour in business life and honour in private life.

The phrase "Business is Business" acts as an anæsthetic on some consciences, enabling the possessor to adopt sharp practices; to "sail near the wind;" to give short measure in quantity or in quality of service; to act, indeed, in the shop or counting house as he would never dream of acting on the cricket field, on the golf links, or in daily relation with his friends. Such are they who regard business as a daily warfare between buyer and seller, with *caveat emptor* as its battle cry. But, as understood by the most truly successful men in it, business is not a warfare between buyer and seller, but a form of mutual service based on the golden rule of "Whatsoever ye would that men should do unto you, do ye even so unto them." If, then, for "Business is Business" we substitue "Business is Service for Mutual Profit," we begin to visualize a career for which education can do much to prepare boys and girls before any question of specifically vocational education or training arises. Commerce is indeed a career which, while being interesting, exciting, and adventurous on the one hand, can be, on the other, worthy and honourable, as well as profitable.

Hitherto commerce has not been recognized as a science at all. The vitally important business of marketing the products of this great industrial country has been regarded by all too many of those engaged in it as something that "anyone can pick up," and so young men and women go into business without previous suitable education or training, and get such knowledge and acquire such skill as they do ultimately possess as best they may, with little, if any, specific education or training either from without or within the business in which they are engaged.

Many of those employers who realize more or less vaguely that this is wrong and begin to think about it, make the mistake of thinking that, because of the infinite variety of businesses that exist, business cannot be reduced to a science and studied as such. The mistake lies in failing to see that there is a science of business with clear principles of universal application, and that it is only in the knowledge, skill, and methods required for putting those principles into practice in varying trades that variations occur. The same principles apply to selling lemons as to selling locomotives, to selling meat as to selling motor cars. Those principles constitute the science, and their application in each industry the art, of commerce, and the study of that science and that art has advanced little in the past twenty-five years because the existence of the fundamental science has not been recognized.

The second reason why there has been so little development in education for commerce, in the wide sense of the words, since 1910 is the simple fact that neither commerce, on the one hand, nor education, on the other, has realized fully the existence of the necessity or investigated the possibilities of meeting it.

The Task of the Association.

The task, first, of determining the exact nature of the educational needs of commerce before and during employment; and, second, of considering how best those needs can be provided or how better existing facilities can be utilized or adapted to meet those needs, is that which engaged the attention and earnest study of the Salesmanship Committee and continues to engage the British Association for Commercial and Industrial Education.

We fully realize the dangers of early specialization for any career, and not less for business than for other professions and that sound and broad general education and its product culture are essential as a foundation for expert knowledge.

We realize the value in commerce, as in life generally, of art and imagination in combination with learning, and the importance of the capacity for self-expression by the spoken as well as the written word.

The Committee issued a second Interim Report dealing specially with the importance of being able to express one's self generally by tongue, as well as pen, in other languages as well as in one's own—a point of great importance in our Overseas Commerce.

Public School and University Men for Business.

I should like, before I conclude, to touch upon the suitability of recruits from public schools and universities for employment in commerce and industry, and for that purpose I should like to make a few quotations from the Final Report of my Committee, which says: "We are clear that there is far greater willingness on the part of undergraduates to enter commerce than was the case even thirty years ago," and that from the evidence of witnesses who have recruited graduates and find the results satisfactory, we were able to extract such opinions as: "The firm did not look for academic qualifications directly bearing on the work to be done, though history, law, logic, or science were valuable in opening and developing the student's mind and valuable, therefore, as a preliminary training for salesmanship."

Let me conclude by expressing the hope that everyone in this country will realize that the day of science is here in commerce as in industry.

Reconstructed gasholder and general construction workshop.

R. & J. Dempster, Ltd.,

Celebrate their Jubilee

Fifty years' unbroken service to the Gas Industry is a record of which any firm may well be proud, and 1935 is therefore a "red-letter year" for R. & J. Dempster, Ltd., who founded their Manchester Works in 1885. In the intervening years they have specialized almost entirely in meeting many of the varied requirements of the engineering side of the Gas Industry.

During fifty years, which have seen so many changes in the Industry both in personnel and in plant, "R. & J. D." have attained an eminence which has made their name a household word wherever gas is manufactured, and the present generation of the Firm pays full tribute, for the position it now holds, to the business acumen and grit of the late Robert and John Dempster, who laid such solid foundations half-a-century ago. The family is still represented in the business, Mr. Charles Dempster being the present Chairman. We believe, too, that Mr. J. Winson Scott, a Director, who is known wherever the Gas Industry meets, can claim even more than Jubilee service, having gone to Manchester with the Firm from its previous Yorkshire existence.

In order to keep pace with increasing demands and to maintain plant in up-to-date condition, periodical enlargement of works has been called for, with, of course, acquisition of additional land. Many patents stand in the name of the firm, the "Bearscot" being perhaps among the most universally known. More particularly is this the case in the realm of gasholder construction, Messrs. R. & J. Dempster having been responsible for a large percentage of the special type erected not only in this country, but also overseas. A fine example of the work in this direction carried out by the Firm is the 7-million capacity holder at Belfast—the largest of its type in existence. It is interesting to recall that this particular holder was inaugurated at the time when a Gas Institute meeting was held in the City.

In more recent years Messrs. Dempster have installed special plant for manufacturing waterless holders of the M.A.N. type. Here again the largest example of the kind erected in the British Empire was carried out by them for the Gas Light and Coke Company at their Southall Works. This holder, apart from its own particular functions, is also a well-known landmark for aviators approaching the Metropolis.

All the most up-to-date equipment finds its place in Messrs. R. & J. Dempster's works, many of the sections of which are close on 400 ft. in length, spacious, and airy, with sunk rails for handling goods quickly and easily on trucks. Each bay has its overhead travelling crane, while a further noteworthy feature of the works is the commodious templating room, close to the boiler shop, where full-size templates can be made for all requirements.

The accompanying photographs give some impression of the magnitude of the Gas Plant Works, Oldham Road; and many friends in the Industry will join us in congratulating Messrs. R. & J. Dempster upon their fifty years of progress and service to the Gas Industry.

New buildings in course of erection, with old shops behind awaiting removal.

Bulk Supply Inaugurated.

Edinburgh's 7-Mile Main.

Mention was made in the "JOURNAL" for Jan. 9 of the Edinburgh Gas Department's scheme to give Broxburn a bulk supply. Now that the scheme has been completed, we are able to give some further particulars of the work which, with the exception of welding, was done by the Gas Department staff, augmented by local labour. The number of men employed reached a maximum of 130, of whom 115 were engaged through the Employment Exchange.

The total number of joints welded was 1,428. The time taken for the laying of the mains was seven months, progress at one time reaching a rate of 1,000 yds. a week.

This 7-mile main has a diameter of 9 in., and conveys gas from the Edinburgh Corporation works at Granton to the boundary of their area, where a huge meter has been erected in a house of brick. From this point for a further mile and a half the pipe continues to Broxburn village. This is the first extension of the Edinburgh gas supply to extraneous areas, and at the inauguration proceedings on Tuesday, Jan. 15, it was indicated that it is probably only a beginning. The supply of gas to distant centres has been found to be a practical and economical proposition, and this new development will open up possibilities of lighting small villages in country areas which had formerly to depend on other methods of illumination.

The inauguration ceremony was performed by Lady Thomson, and was attended by Lord Provost Sir William Thomson and representatives of the Edinburgh Corporation Gas Committee and the Engineering Staff.

A Luncheon was afterwards held at the North British Station Hotel. Councillor Muter presided, the company numbering about sixty, and including Lord Provost Sir William Thomson and Lady Thomson; Mr. D. Robertson, Convener of the County of Linlithgow; Mr. Ernest Brown, M.P., Secretary for Mines; Mr. J. C. M. Guy, M.P.; Bailie Raithby, Lord Dean of Guild Wilson, Treasurer Brown, Mr. Fergus Harris, Mr. J. Jamieson, Engineer and Manager, Edinburgh Gas Department, and Mr. H. H. Gracie, former Engineer and Manager of the Gas Department.

The "Ferrolene" Cutting Process

A New Industrial Outlet for Gas

On Jan. 17, representatives of the Industrial Gas Development Centres visited Watson House to witness a demonstration of the "Ferrolene" cutting process, for which many advantages are claimed over the oxy-acetylene method.

This demonstration was organized at Watson House by the Gas Light and Coke Company in co-operation with the patentees of the process—Messrs. Oxy-Ferrolene, Ltd., of Piccadilly House, Lower Regent Street, London—in order to acquaint the various Industrial Gas Development Centres with this new method of cutting, which may well prove, if all the claims made for it can be justified, a very valuable additional outlet for gas on the industrial side.

The process has only been in operation in this country for about a year or so, having had its origin in the United States. It is known as the "Ferrolene" process and may be briefly described as follows:

Coal gas used as a vehicle is impregnated with the vapour of a liquid known as "Ferrolene." This may be carried out by any one of three methods:

1. A portable installation supplied by the patentees consisting of a small compressor and saturator, which connects to any gas supply, and delivers the impregnated gas at 5 lbs. per sq. in. pressure to the cutters.
2. A fixed installation on similar lines to the above, connected to the outlet of consumer's meter and delivering impregnated gas into a main pipeline from which the individual cutters are fed.
3. Impregnated gas compressed into steel cylinders for transportation.

The following phenomena are claimed to take place with the mixture:

1. The ignition point of the gas lowered.
2. The propagation of the flame is retarded.
3. The intensity of the flame is increased.
4. The flame temperature with oxygen is greater than with oxy-hydrogen.

Advantages of the Process.

It is claimed that "Ferrolene" shows a saving of 33-40% on acetylene, *plus* a definite saving of oxygen due to the narrower cut, and with the following advantages.

1. Less danger in handling than with acetylene.
2. Non-injurious to sight, as the flame is not incandescent.
3. Cost much lower than acetylene.
4. Speed of cut about equal to acetylene.
5. No residual sludge.
6. Surfaces of cut not oxidized, therefore much easier machined.

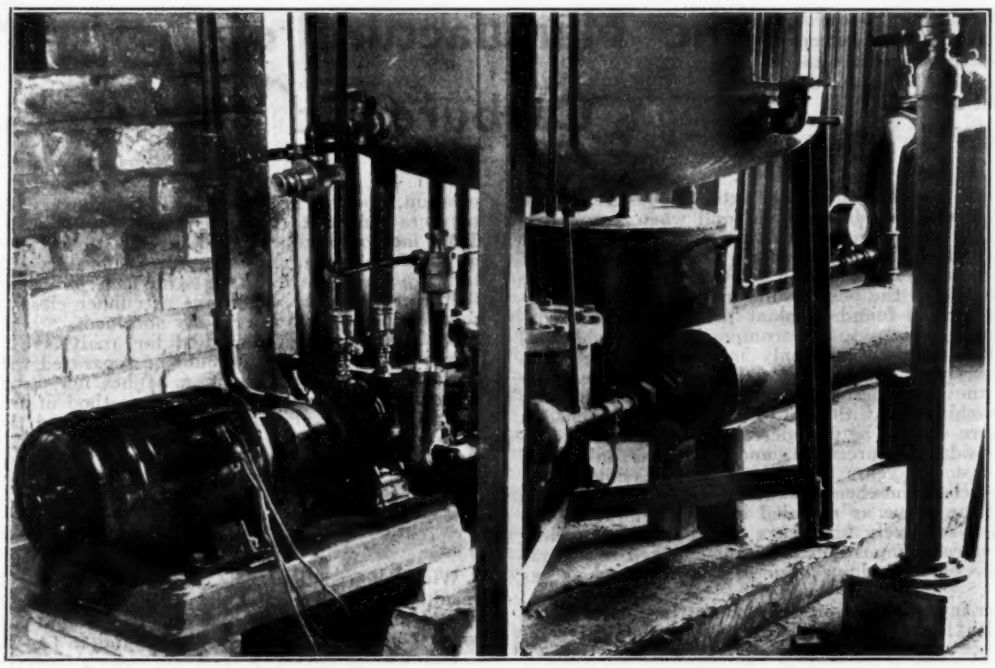
The process was referred to by Mr. Sydney Smith, of Dunfermline, in the course of his Presidential Address last October to the Eastern District of the Scottish Junior Gas Association, when he observed that apart from metal cutting, the gas is used in place of hydrogen for the manufacture of hard glass such as Pyrex, and in the manufacture of radio broadcasting valves.

From data provided from tests carried out by the Weirton Steel Company, of Weirton, U.S.A., with coke oven gas alone and with coke oven gas combined with "Ferrolene" it appears that the use of "Ferrolene" in conjunction with oxy-coal-gas may lessen the cutting costs per ton as compared with oxy-coal-gas alone.

Some Test Results.

The following are extracts from tests carried out by the Weirton Steel Company.

> "The tests were carried out in cutting an 8 in. by 8 in. bloom and a 2 in. by 26 in. slab across the section."
>
> "The cutting was done with a mechanical feeding type cutting machine to eliminate error of hand variation. In



Typical Example of Oxy-Ferrolene Cutting Plant, Showing Compressor, Storage Tank, and Saturator.

each test the cutting proceeded until a full tank of oxygen was exhausted and the burners went out."

"Taking into account labour, oxygen, and gas costs per 1,000 sq. in. of cut, the total for oxy-acetylene cutting was 4·136 dollars (17s. 3d. at par), and using coke oven gas and oxygen with 'Ferrolene' the cost was only 1·836 dollars (7s. 8d. at par)—a very material saving."

". . . taking oxy-acetylene as 100% it is found that cutting with coke oven gas, oxygen, and 'Ferrolene' the total cost is only about 45%."

"The cheapest cutting without the use of 'Ferrolene' was with oxygen and coke oven gas which showed a total cost of 2·857 dollars (11s. 11d. at par) per 1,000 sq. in., and this was about one dollar higher than when 'Ferrolene' was used."

The following figures and costs were used throughout the tests:

Labour	45c. (1s. 10½d.) per hour.
Oxygen	65c. (2s. 8½d.) per 100 c.ft.
Acetylene	(1,477 B.Th U.), 220c. (9s. 2d.) per 100 c.ft.
Coke oven gas	(585 B.T.U.) 12c. (6d.) per 1,000 c.ft.
"Ferrolene"	100c. (4s. 2d.) per 100 c.ft.

The coke oven gas was used at 5 lbs. per sq. in. pressure and impregnated with approximately 2½% of "Ferrolene."

The Inverkeithing Gas Company has laid a 4-in. steel main to supply gas into the Shipbreaking Yard of Messrs. Thomas W. Ward. The latter Company has been using the "Ferrolene" process in many of its yards in the south, and purposes using it at Inverkeithing, it is understood, to the complete exclusion of acetylene.

Further points we gathered at the demonstration included the fact that Messrs. Oxy-Ferrolene, Ltd., are prepared to install the plant on a rental basis, and when the gas undertaking read the meter duplicate slips are issued and the patentees charge a small Royalty. The cost on this basis is 12s. 6d. per 1,000 c.ft., which works out at about 40% cheaper than acetylene. The calorific value of the gas is raised to about 750 B.Th.U., and one gallon of "Ferrolene" is used per 1,200 c.ft. of gas. One of the principal secrets of the success of the process lies in the fact that there is a further mixing chamber in the head of the torch.

The representative of the patentees informed us that his firm supply "Ferrolene" plants in two sizes—one to provide for up to ten cutters and the other up to 60. One of the largest plants is in operation at the works of General Motors, Ltd., in America, in which country, by the way, insurance companies allow a 2% lower premium to firms using this process by reason of there being no risk of blow-back.

The following table gives further comparative figures for acetylene and "Ferrolene":

June 2, 1932.	Acetylene.	Ferrolene.
Material cut—mild steel—		
Size of tip	No. 3	No. 3
Weight of gas cylinder before using	231 lbs.	140·5 lbs.
" " " after using	226 "	138 "
Gas—		
Lbs. of gas used	5·0	2·5
Ft. per lb. of gas	14·5	33
Cost per 1,000 c.ft.	$20·00	$10·00
Cost per ft.	$ 0·02	$ 0·01
C.ft. used	72·5	82·5
Cost of gas consumed	$ 1·45	$ 0·825
Oxygen—		
Weight of oxygen cylinder before use	..	144 lbs.
" " " after use	..	128 "
Lbs. of oxygen used	23	16
Ft. per lb. of oxygen	12·08	12·08
Cost per ft. of oxygen	$ 0·008	$ 0·008
C.ft. oxygen used	277·84	193·28
Cost of oxygen consumed	$ 2·222	$ 1·546
Cutting—		
Number of pieces cut	8	8
Linear inches cut per minute	7	8¾
Depth of material cut, inches	4¼	4¼
Linear inches cut	375·5	370
Square inches cut	1,548·93	1,526·25
Total cutting time	53 mins. 37 secs.	42 mins. 28 secs.
Labour—		
Labour cost per minute	$ 0·01	$ 0·01
Total labour cost	$ 0·5337	$ 0·4228
Total cost—		
Gas cost	$ 1·45	$ 0·825
Oxygen cost	2·222	1·546
Labour cost	0·5337	0·4228
Total cost	$ 4·2057	$ 2·7938
Sq.in. cost—		
Gas cost per 100 sq.in.	$ 0·0936	$ 0·054
Oxygen cost per 100 sq.in.	0·1434	0·1012
Labour cost per 100 sq.in.	0·0343	0·0277
Total cost per 100 sq.in.	$ 0·2713	$ 0·1829

% savings with "Ferrolene," 32·59.

One of the largest jobs which has ever been performed by an "Oxy-Ferrolene" machine was the cutting of a 36-in. diameter shaft.

Among those present at the demonstration were Sir Francis Goodenough, C.B.E., and Mr. J. R. W. Alexander (Secretary of the Institution of Gas Engineers). Mr. W. Dieterichs, who is in charge of the Watson House Industrial Centre, voiced the thanks of those present to Messrs. Oxy-Ferrolene, Ltd., for arranging the demonstration, in the course of which various steel bars, plates, and sections had been cut through with remarkable ease and rapidity.

Evaluation of Oils for the Manufacture of Carburetted Water Gas

by P. J. HERKUS* and A. H. WHITE†

In a Paper before the Technical Section of the A.G.A., the Authors discuss an evaluation method based upon the available hydrogen content of the oils.

The manufacture of carburetted water gas has reached a high state of technical development and when a new carburetting oil is to be introduced, modifications of plant operation are tested until the most desirable method of operation has been found. When operating conditions have been adjusted until the best results are obtained, the carburetting values as found in plant practice may be considered as due mainly to the composition and chemical nature of the oil used and only in a minor degree to defects in its treatment in the water gas set. It has only been since the introduction of the modern mechanically-operated machines that the water gas set has reached a position where it may be considered as a scientific instrument of considerable precision, and so it has only been within the last few years that it has been feasible to attempt to correlate the chemical composition of the oil with its carburetting value as revealed in practice. It is also only within a relatively few years that gas oils of widely varying chemical composition including cracked residuums and asphaltic base oils have been successfully used as gas oils.

The earlier investigators of the carburetting value of gas oils met with little success in correlating chemical composition, specific gravity, distillation curves, and laboratory cracking tests with the results obtained in the plant. Their lack of success was due in part to the uneven results of plant operation, and in part to the crudity of the laboratory cracking units. These latter have now been improved to the point where conditions are under close control and reproducible results are readily obtained.

Griffith[1] proposed a method for analysis by which the constituents of a gas oil could be separated with approximate accuracy into paraffines, naphthenes, aromatics, and unsaturates. Mighill[2] proposed a method of analysis leading to a similar classification. He proposed the following table of carburetting efficiencies:

	%
Paraffines	80
Naphthenes	70
Aromatics	50
Unsaturates	25

Wing[3] showed that these analytical methods gave erratic results, and cited one oil which when tested by three skilful analysts showed such widely different figures as 5·4 and 60·3% of naphthenes and 23·5 and 75·4 of paraffines.

Holmes[4] proposed a relation which involved specific gravity, dispersion of light, and the average boiling point of the oil, and showed that there was considerable correla-

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† Professor of Chemical Engineering, University of Michigan.

tion between his calculated results and those obtained in a laboratory cracking furnace.

The variation in the chemical composition of the fractions of various crude petroleums has been excellently summarized by Frolich[5] in the following statement:

> The types of hydrocarbons present in petroleum vary with the origin of the crude oil, but in all cases the lower fractions consist of paraffin hydrocarbons ranging from methane upwards. The intermediate cuts are partly paraffines and partly single-ring naphthenes, while the heavier components consist largely of single and condensed rings with paraffinic side chains of varying length. Although simple paraffin hydrocarbons of high molecular weight are found in considerable amounts, particularly in the so-called paraffin base crudes, Mabery's work has shown beyond doubt that the greater portion of the paraffinic constituents exist as radicals linked to ring compounds, the rings being either naphthenic or aromatic in character. As far as is known, olefins and diolefins are not found in the original crude. Analyses of various types of crude oils show that they contain on the average two atoms of hydrogen, or slightly less per atom of carbon. Actually, the ratio of hydrogen to carbon is higher in the lighter fractions (as exemplified by the lower paraffines: C_nH_{2n+2}), but decreases gradually as the molecular weight rises. The hydrogen content of the high-boiling fractions therefore is considerably lower than the average 2:1 ratio. This progressive decrease in the hydrogen-carbon ratio with increasing boiling point is an important factor in the cracking and hydrogenation of petroleum.

The literature on pyrolysis of hydrocarbons deals mainly with lower temperatures and longer contact times than are met in water gas practice. It is clear, however, that the aromatic hydrocarbons are the most stable towards heat and that when they do decompose they give off hydrogen rather than hydrocarbons of low molecular weight and that paraffines yield the largest proportion of fixed hydrocarbon gases. There would thus seem to be at least a fair ground for believing that the hydrogen content of a gas oil should give an indication of its carburetting value. The small value of tars as a carburetting agent might also be explained by their low percentage of available hydrogen; available hydrogen being defined as the surplus hydrogen after all the oxygen in the compound has been calculated as being in combination as H_2O.

One of the obstacles to the investigation of this relationship of available hydrogen to carburetting value has been the tediousness of the methods for ultimate analysis of a fuel. These methods have been shortened as described in another paper presented at this meeting[6] whereby a complete analysis for carbon, hydrogen, oxygen, nitrogen, and sulphur can be completed in connection with a determination of heating value in a bomb calorimeter in less than four hours. Another of the obstacles to an investigation of this relationship has been removed with the improvement of laboratory cracking furnaces and the improved adaptability of the modern water gas set to carburetting oils of various types.

It seemed, therefore, worth while to secure samples of gas oils whose carburetting values had already been determined in a laboratory cracking unit and if possible confirmed by plant tests, and to make ultimate analyses of these oils and determine if there was any correlation to be found between the available hydrogen content and the carburetting value as determined experimentally.

Experimental Data on Gas Oils.

The first group of samples was obtained through the courtesy of A. Holmes, of the Standard Oil Company, New Jersey, and were some of the oils used in the study to which reference has been made.[4] Eight samples of oil submitted by Holmes were analyzed and the percentages of hydrogen compared with his experimental data on carburetting value. The data are given in Table I. and the relationship of the hydrogen percentage to the carburetting value expressed as pounds of oil for 1,000 c.ft. of 530 B.Th.U. gas is shown in fig. 1.

Additional samples of gas oils of known carburetting value were then secured from the Detroit City Gas Company, the Consolidated Gas Company of New York, and the Marysville Plant of the Detroit Edison Company. These samples were all analyzed for hydrogen, and the data, together with the information furnished by the donors of the samples, are to be found in Table I. The values furnished by the Detroit City Gas Company were determined in their cracking furnace at 1,400°, 1,500°, and 1,600° F. There was no great variation between the three temperatures, and the data for 1,500° are used in this Paper. The data from the Consolidated Gas Company were obtained in their laboratory cracking furnace.[6] The values reported are those taken from the curves at 1,500° F., and the volume of oil gas has been taken as 50 c.ft. per gallon. These figures represent substantially the optimum conditions for all except the heavy oil 130-32, and correspond to the conditions under which the other oils were tested. With this heavy oil optimum conditions were obtained in the cracking furnace at 1,600° F. with 45 c.ft. of oil gas per gallon and 75,000 B.Th.U. per gallon of oil. Under these more favourable conditions 34·0 lbs. of oil would be needed for each 1,000 c.ft. of 530 B.Th.U. gas instead of 36·7 as reported in Table I.

The data from the Marysville plant of the Detroit Edison Company came from the plant tests made by E. S. Pettyjohn in his research work for the Michigan Gas Association. These tests were made with bituminous coal as a generator fuel.

Before discussing the results it should perhaps be reiterated that the only work which we have done has been to make the ultimate analyses of the oils and to recalculate the results of the carburetting values to a uniform basis of pounds of oil per 1,000 c.ft. of 530 B.Th.U. gas. The heating value of blue gas from a coke generator has been taken as 290 B.Th.U. per c.ft.

Table I. contains data on 35 oils varying from a light gas oil with a specific gravity of 0·8163 and a hydrogen content of 14·17% to a heavy residuum with a specific gravity of 1·0377 and a hydrogen content of 9·14%. The interpretation of the data can best be obtained from fig. 1, which correlates the carburetting value with the percentage of hydrogen. Curve A includes the results from all of the oils furnished by the Standard Oil Company of

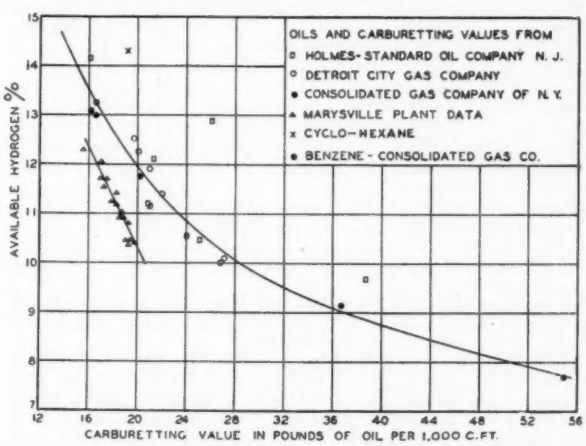

Fig. 1.—Relation of Available Hydrogen Content and Carburetting Value.

New Jersey, the Consolidated Gas Company, and the Detroit City Gas Company. One of the points is far off of the curve and there is no explanation to be offered for the discrepancy. The carburetting test was made some months before we asked for the sample for ultimate analysis and only a small laboratory sample of the oil had been saved, so that it was not possible to repeat the furnace test. The other 18 samples all fall fairly close to the curve, perhaps unexpectedly close when the variety of oils and the diversity of furnace tests are considered.

Carburetting tests on two pure compounds are also included in fig. 1. The value of cyclo-hexane is taken from the report of Murphy.[7] His apparatus and procedure were somewhat different from those used by the other investigators, but the result is in general agreement with the others. The test showing that 54·9 lbs. benzene (C_6H_6) with 7·7% H were needed per 1,000 c.ft. of 530 B.Th.U. gas, was made at the laboratory of the Consolidated Gas Company of New York in order to determine how a cyclic compound with low hydrogen would behave. The result falls on a prolongation of the curve which passes through the other points.

The results of Pettyjohn from full plant scale tests fall on a straight line which is steeper than the curve obtained from the laboratory cracking tests. It should be repeated, however, that these results of Pettyjohn were obtained with a producer using bituminous coal as fuel, and, therefore, the quantity of oil required to produce 530 B.Th.U. gas should be less than when coke is used as fuel. The curves support this assumption.

Carburetting Value of Tar and Alcohol.

The carburetting value of tar has been a disputed question, but the general impression has been that it was valueless as a carburetting agent. Two samples of coal tar and two of water gas tar from the works of the Grand Rapids Gas Company were analyzed with results to be found in

TABLE I.—*Data on Gas Oils.*

Oil Number.	Sp.Gr. 60°/60°.	Source and Type.	A.S.T.M. Distillation. IBP.	20%.	50%.	75%.	FBP.	Carburetting Data. 1,000 B.Th.U./ Gal.	Gals./ 1,000 C.Ft.	Lbs./ 1,000 C.Ft.	Chemical Analysis. % C.	% H.	% S.	% N.	% Ash.	Total.
Std. Oil Co. of N.J. Samples.																
BYY	0·8525		350					94·0	2·94	20·92	87·79	11·15	1·02	0·07	0·02	100·05
COL-OO	0·8763							93·3	2·85	20·84	87·13	11·20	1·58	0·14	0·02	100·07
WT-CS	0·9024	Cracked gas oil (West Texas)	350		561		760	84·1	3·33	25·02	89·12	10·46	0·30	0·17	0·03	100·08
WT-CS-FB	0·8866	Cracked gas oil	473		517		578	88·2	3·27	24·12	86·50	10·55	1·27	0·59	0·04	98·95
PA-OO	0·8163		345		543		702	118·5	2·38	16·17	85·80	14·17	0·02	0·03	0·00	100·02
WT-OO-SE	0·9001		385		575		740	88·6	3·34	25·10	85·37	12·89	1·64	0·09	0·02	100·01
PGOB-3O	0·9001	Paraffin gas oil	296		720		777	97·6	2·85	21·36	87·00	12·10	0·75	0·07	0·00	99·92
WT-CS-FC	0·9106		542		588		690	59·5	5·10	38·67	86·37	9·68	1·41	0·19	0·03	97·67
Detroit City Gas Co. Samples.																
6,438	0·9908	Dubbs residue						89·0	3·22	26·80	89·33	10·00	0·99	0·04	0·00	100·36
344	0·9609	Bunker C oil	410	599	690	715	724	101·5	2·75	22·05	86·50	11·40	1·91	0·07	0·09	99·97
2,221	0·9216	Low viscosity fuel oil	432	501	567	649	769	82·4	3·53	27·13	88·65	10·10	0·57	0·41	0·00	99·73
6,742	0·9032	Refinery cracking stock	397	608	704	729	735	104·3	2·67	20·12	87·43	12·25	0·49	0·13	0·00	100·30
1,962	0·8800	Topped Michigan crude	441	538	686	723	773	103·7	2·69	19·70	86·98	12·52	0·88	0·16	0·00	100·54
1,136	0·8594	Motor oil diluents	322	397	562	706	770	96·2	2·94	21·02	87·55	11·90	0·10	0·28	0·08	99·91
6,721	0·8240	Straight run gas oil	418	516	580	629	727	113·8	2·41	16·60	86·68	13·25	0·00	0·12	0·00	100·05
Consolidated Gas Co. Samples.																
362-33	0·8537	Straight run	375	495	561	618		117·0	2·34	16·65	86·27	13·00	0·38	0·16	0·00	99·81
363-33	0·8573	Straight run	340	529	596	657		120·0	2·27	16·23	85·98	13·18	0·36	0·31	0·00	99·83
366-33	0·9352	Straight reduced crude						107·0	2·59	20·20	86·07	11·76	1·69	0·17	0·03	99·69
130-32	1·0377	Pressure still residuum						71·0	4·24	36·71	87·54	9·14	2·51	0·53	0·01	99·72
Marysville Samples.																
M-4	0·8300								2·76	19·28	88·46	10·80	0·06			
M-6	0·8393								2·23	15·59	87·78	12·30	0·00			
M-9	0·8600								2·62	18·75	87·70	11·05	0·24			
M-12	0·8433								2·43	17·03	85·12	12·03	0·86			
M-14	0·8433								2·55	17·89	87·67	11·25	0·41			
M-15	0·8426								2·50	17·51	88·20	11·71	0·12			
M-17	0·8550								2·58	18·37	87·11	11·42	0·34			
M-19	0·8334								2·61	18·32	87·50	11·20	0·41			
M-5	0·8396								2·45	17·13	88·14	11·72	0·11			
M-7	0·8375								2·67	18·62	88·64	10·92	0·37			
M-10	0·8604								2·67	19·16	89·12	10·45	0·27			
M-11	0·8600								2·69	19·28	89·47	10·46	0·11			
M-13	0·8460								2·45	17·26	88·03	11·60	0·67			
M-16	0·8397								2·76	19·28	88·41	10·41	1·00			
M-18	0·8540								2·79	19·82	88·87	10·43	0·51			
M-20	0·8435								2·68	18·79	88·71	10·92	0·12			

Table II. It will be observed that the percentage of hydrogen varies from 4·90 to 5·10, far below the lowest value of the petroleum oils tested.

Ultimate analyses of low-temperature tars have been reported by Davis and Galloway[8] and their data are also reported in Table II. The total hydrogen values range from 7·2 to 9·0, but the available hydrogen remaining after deducting for the oxygen of the tars varies from 6·2 to 8·4, a value which is lower than that of any of the gas oils reported. The figures on available hydrogen content thus confirm the opinion that tars have very little carburetting value.

TABLE II.—*Data on Tars.*

Kind of Tar.	Sp. Gr.	Chemical Analysis. % C.	% H.	% S.	% O.	% Available Hydrogen.
Coal tar		92·00	5·10	2·00		
		91·82	5·00	1·80		
Water gas tar		93·16	5·40	0·38		
		91·75	4·90	1·85		
Low-temperature tar[8]	1·0687	85·5	8·2	0·7	4·8	7·6
	1·0622	84·3	8·4	0·7	5·9	7·7
	1·0888	87·0	7·2	0·9	4·4	6·7
	1·0556	78·5	8·5	1·1	11·3	7·1
	1·0945	82·1	7·3	0·5	9·2	6·2
	1·0204	83·4	9·0	0·9	6·2	8·2

In order to provide a test on another compound with considerable oxygen, the Consolidated Gas Company determined the carburetting value of absolute ethyl alcohol in their experimental cracking unit. C_2H_5OH contains 13·05% total and 8·7% available hydrogen. It should, therefore, have a higher carburetting value than benzene with 7·7% hydrogen. The alcohol does yield 82 million B.Th.U. per gallon as compared with 39 million B.Th.U. per gallon of benzene. However, the gas formed from alcohol has a heating value of only 498 B.Th.U. per c.ft., and so it manifestly is impossible to use alcohol to enrich 290 B.Th.U. blue gas to a value of 530 B.Th.U. The detrimental effect of oxygen is thus greater than would be accounted for on the basis of its available hydrogen. This again confirms the opinion that tars can have very little carburetting value.

Conclusions.

The percentage of available hydrogen in a gas oil has been shown to bear a close relation to its carburetting value. Results are presented for three groups of gas oils which had been tested in the laboratory cracking units of the three companies furnishing them. These carburetting values are correlated with the percentage of hydrogen and the results for the 19 oils varying in specific gravity from 0·8163 to 1·0377 fall, with one exception, fairly well on a curve whose trend is indicated by the following values:

% Available Hydrogen in Oil.	Pounds of Oil Required for 1,000 C.Ft. of 530 B.Th.U. Gas.
14·0	14·0
12·0	19·6
10·0	28·0
9·0	37·0
8·0	51·0

These data indicate that gas oil with 14·0% hydrogen is worth twice as much per pound as one with 10·0% hydrogen and that the carburetting value of oils falls off very rapidly when the hydrogen is below 9%. Since modern coal and water gas tars contain only about 5% and low-temperature tars only 6 to 8% of hydrogen it appears that their carburetting value will be negligible.

When bituminous coal is used as generator fuel instead of coke, less oil is required to produce a gas of desired heating value. Results of plant tests of 16 oils show a good correlation with the hydrogen content and the curve does show a smaller amount of oil is required. The slope of the curve indicates that heavy oils may be used more advantageously with bituminous coals than with coke.

This correlation of available hydrogen content with the carburetting value of gas oils seems to hold with a wide variety of oils and to deserve a more careful study.

This investigation was made possible through the financial support of the Michigan Gas Association and the co-operation of C. A. Lunn, of the Consolidated Gas Company, J. W. Batten, of the Detroit City Gas Company, A. Holmes, of the Standard Oil Company of New Jersey, and E. S. Pettyjohn, of the University of Michigan.

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Heat Economy in the Industrial Applications of Town Gas

by
L. G. A. LEONARD

In a paper before the Wales and Monmouthshire Junior Gas Association at Cardiff on Dec. 15, Mr. L. G. A. Leonard, of British Furnaces, Ltd., emphasized that there still remains in many heating operations wide scope for the practice of fuel economy.

During the last decade there has been an increase in the efforts to develop new and better manufacturing methods, and the science of economically controlling heat is of greater importance than in the past. The laws of heat generation and transference are widely and better known, but there still remains in many heating operations wide scope for the practice of fuel economy. Conditions often imposed render difficult the most efficient operation of a furnace as a thermal machine, and particularly is this true in the heat treatment of valuable materials.

In the design of a furnace, a compromise has often to be made between essential manufacturing needs, such as works conditions, rate of production, and the nature of the heating process. In spite of these imposed factors, great progress is being made in the development of gas furnaces, and particular attention is being given to all methods of improving efficiency. For high temperature heating such as is required in most gas-fired industrial furnaces the most efficient combustion process is that known as "surface combustion." This is a system of burning gaseous fuel homogeneously pre-mixed with sufficient air to form an explosive mixture, even to the point where the fuel is completely burned and no free oxygen left. Incandescent surfaces are used in this process to increase the speed of reaction between the combustible gases and oxygen, to such an extent that the steady process of combustion is accelerated to the point of being instantaneous.

The advantages obtained are:

(1) Perfect combustion is attained with no excess of air and no trace of unburnt gas escaping.
(2) Much higher furnace temperatures can be reached than by ordinary methods of gaseous combustion, without resorting to the preheating of air.
(3) The absorption of heat by the object heated is very rapid, due to the maximum amount of radiant energy developed.
(4) Combustion can be concentrated just where the heat is required.
(5) The process is in no way dependent upon flue draught or other external conditions.

That the fuel should be conserved and as much heat as possible usefully employed is the chief tenet of every furnace designer. The function of the gas burning system is to deliver an adequate quantity of heat in the correct form required by the process. Apart from this, the furnace is the determining factor of efficiency. Dissipation of heat is inherent in all gas-heated furnaces and the loss occurs from the following sources.

(1) Heat transmitted to walls and lost by conduction and radiation therefrom.
(2) Sensible heat lost by leakage of gases through doors and lighting holes.
(3) Heat lost in spent gases leaving through flues.
(4) Heat absorbed by material leaving the furnace.
(5) Heat lost due to incorrect operating conditions. Heat lost through walls, &c.

Reduction of Heat Loss.

Reverting to the first source, reduction of the heat lost through walls is of great importance, since any improvement effected here will also lower the quantity of heat discarded through the flue, as well as making operating conditions more comfortable for the workmen. The ideal insulator between two walls or surfaces would be a vacuum if the temperature of the hot surface was below a point where radiation occurs. However, as heat may be transmitted in considerable quantities by radiation in waves similar to those of light, regardless of the absence of conduction and convection, it follows that no substance can be considered a true insulator. For some time there was a belief that because air is a poor conductor of heat, dead air spaces in furnace walls would prevent or reduce the heat loss. This artifice defeats its own purpose at high temperatures, because the hot surface radiates heat so rapidly that a greater amount is lost across the space by radiation than would be conducted were the space filled with firebrick. Besides the intense radiation through air at high temperatures, there is also rapid convection which increases with the difference in temperature between the surfaces. The term "dead air space" is therefore a misnomer, and might be well altered to "live air space." However, when the air space is distributed in extremely small pockets, within relatively low-conducting solids, the properties of conduction and convection are reduced, and therefore the air space under these conditions will be a good insulator. The materials used as insulation at temperatures up to 100° F. are cork and hair felt, and for temperatures up to 1,000° F. asbestos, magnesia, and rock wool. Natural diatomaceous earth is used up to 1,600° F., and the same material calcined and bonded, for temperatures of 2,000° F.

A great deal of attention is now being given to the proper insulation of heating appliances, and furnace manufacturers are anxious to supply plenty of insulation with high-grade refractories if permitted. Of course, the purpose for which a furnace is to be used is the governing factor in deciding upon the thickness of firebrick and insulation.

In some furnaces the heat storage made possible by a well-insulated thick refractory lining is of definite value. This is true of enamelling muffles, the doors of which are opened approximately every three minutes, the heat stored in the walls preventing any appreciable loss in temperature. There are other furnaces in which material after being heated to temperature is left to cool before being withdrawn. In such furnaces thick insulation in the walls is a disadvantage, because of the large quantity of gas required to obtain equilibrium temperature conditions and also the long time required to cool down. To overcome this disadvantage, refractory manufacturers are now making a refractory-insulating brick, which weighs considerably less than ordinary firebrick. A furnace lined with light weight refractory-insulation can be heated from cold to working temperature with approximately half the quantity of gas required for a furnace with the ordinary firebrick lining. The temperature can not only be attained more quickly but also decreased more rapidly, without any sacrifice in heat distribution or control. These characteristics are particularly desirable for intermittently operated furnaces or where the heating temperatures must vary widely and frequently during the day.

For operations of this kind, the extra cost of light weight refractory insulation will be paid for in a short time by the saving in fuel. In some furnaces it is possible to construct the waste gas flues so that they surround the heating chamber, or at least a portion of it, and additional savings can thereby be effected.

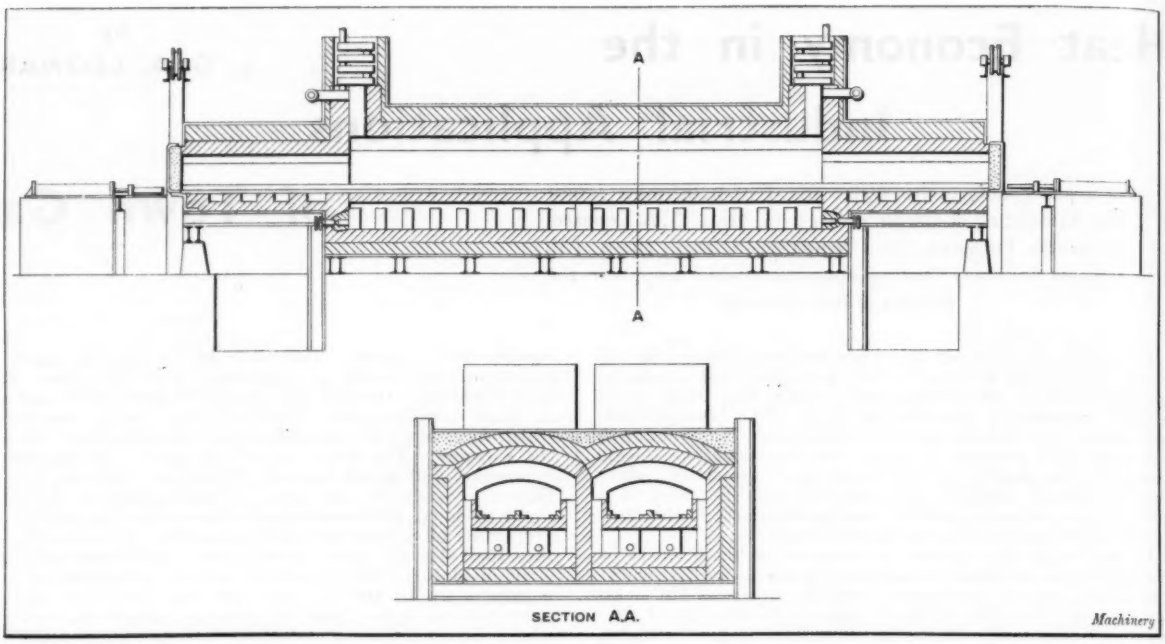
An interesting example of the combined use of waste gases and insulation to reduce heat losses is the Rebate system of heating autoplates and stereotype furnaces.

The conversion of an existing autoplate is carried out on the following lines: The casing of the furnace is insulated to reduce radiation and an airtight hood is placed over that portion of the pot not occupied by the pump and mixer. The products of combustion are conducted into this hood before they pass to the chimney, thus preventing oxidation, and at the same time reducing radiation losses from the surface of the molten metal.

Comparative tests of autoplates at a number of newspaper offices have shown that a saving as high as 35% has been achieved by the use of the hooding and insulation.

The second source of the heat loss, that of leakage through doors, is of importance for the same reasons as that taking place through the walls. Many furnaces work with a slight positive pressure; therefore leakage of gases from the inside to the outside is bound to occur. A door which, when partly opened, forms a flue against the front of the furnace, will cause an uprush of hot gases out of the heating chamber and therefore be a source of loss.

All doors should be arranged to give a good overlap on



COUNTERFLOW CARBURIZING FURNACE FITTED WITH RECUPERATORS.

The furnace proper is made in two separate and distinct chambers, with a solid firebrick wall extending the whole length of the heating chamber. At each end is a heat exchange zone extending across the entire width, and without a separating wall. The fuel consumption of carburizing furnaces of this type is from 85 to 100 c.ft. of 500 B.Th.U. gas per 100 lbs. of gross work.

the bottom as well as on the sides and top, and wedge brackets should be used to keep doors tight when closed.

Recovery of Heat Lost in Spent Gases.

Let us now pass on to the waste gases.

In many applications of gas the greatest waste occurs in the high percentage of heat which leaves the furnace with the flue gases. The higher the working temperature, the larger will be the flue loss, which may sometimes amount to 60 or 70% of the total heat in the gas being burned.

Although the recovery of this heat is both desirable and profitable, the practical fulfilment of heat salvage is often a failure due to the numerous difficulties encountered. There are several methods for combatting loss of heat in the flue gases and these are:

(1) Preheating the air for combustion.
(2) Preheating the material being treated.
(3) Use of waste heat for other operations.
(4) Recirculation of flue gases.

All these methods are being successfully employed in a number of industries, but they are not always used to the fullest possible extent. The fuel saving due to the preheating of air depends largely upon two factors, the working temperature of the furnace and the air preheat temperature; the saving being almost proportional to the latter.

Apparatus for preheating air can be divided into two general types—namely, reversing regenerators and continuous recuperators—each of use in its own particular sphere. While the regenerator can admittedly heat air and gas to a high temperature, and by this means recover the maximum amount of heat from the flue gases, its use is restricted to a limited number of furnaces.

Regenerators are not adapted for furnaces requiring close control of temperature. The advantages of regenerators are that they permit of a very high degree of preheat, and no danger of leakage of the air into the flue gases or *vice versa*.

The disadvantages are their great bulk, high construction and maintenance costs, and the constant attention required to reverse the valves at the proper time.

The continuous recuperator has none of these disadvantages and seems to have greater possibilities for application to gas-fired furnaces. In a recuperator the waste products of combustion pass continuously along one side of a partition wall and the air flows continuously along the other side. The separating walls usually take the form of tubes or ducts, made either of refractory material or metal, the air being delivered to the burners at a relatively constant temperature, and the waste gases evacuated to the chimney at a constant low temperature.

The three elementary forms of recuperators are designated as counter-flow, parallel-flow, and cross-flow. The counter-flow type is the most efficient, and permits a higher degree of preheat from a given flue gas temperature than the other types. Its disadvantage is that the temperature of the partition wall is also higher, necessitating the use of high quality materials in its construction.

The temperature of the separating wall is least in the parallel-flow type, but the preheat obtainable is also low, so that only a small percentage of the heat in the flue gases can be effectively salvaged. The advantages of the cross-flow recuperator are chiefly structural; for instance, compactness of arrangement.

These three primary types may be modified and combined in a variety of ways, and may be constructed in diverse materials. Recuperators constructed of ordinary cast iron or steel are not suitable for temperatures above 800° F. in the flue gases, on account of their tendency to corrode and oxidize. Refractory recuperators can be built to withstand a waste-gas temperature of 2,500° F. with an air preheat of 1,900° F.

Brick recuperators, however, unfortunately possess certain obvious weaknesses and drawbacks, which are very difficult to overcome. The porosity of the material and the tendency for air to escape at the joints makes operation only possible at relatively low air pressures. By reason of brittleness, cracks occur sooner or later and these have exactly the same detrimental effect as leakage at the joints. Refractory materials, with the exception of silicon-carbide and sillimanite, have low coefficients of heat transfer, which necessitate the building of large units. Further, the refractory material has a high heat capacity which diminishes the utility of the recuperator for intermittent furnaces.

Use of Heat-Resisting Alloys.

Through the recent adoption of heat-resisting alloys it has been possible to design recuperators having high rates of heat transfer, so that large and cumbersome units are obviated.

Moderately high air pressures and greater velocities can be used without danger of leakage. One great advantage of the metal recuperator over the refractory type is the ease with which repairs may be executed.

In many refractory recuperators it is impossible to carry out repairs except by simultaneously rebuilding the entire furnace.

Such repairs are time wasting and expensive, and cause serious stoppages of production. The metallic recuperator, on the other hand, is small and compact, and is often placed above the furnace so that it can be removed entirely if repairs are necessary.

A recuperator can give effective economies in the following ways:

(1) By increasing the temperature, the gas consumption and output remaining constant.
(2) By increasing the output from the furnace.
(3) By decreasing the fuel consumption, the temperature and quantity of material heated remaining the same as before recuperation was applied.

This last way is the most usual saving. Even when preheating air to the low temperature of 400° F., with a waste gas temperature of 1,500° F., the possible fuel saving is about 15%.

If complete satisfaction is to be obtained from the installation of a recuperator there are certain precautions to be observed. No flame should be allowed to impinge upon the elements of the recuperator; otherwise the metal will be subjected to a considerably higher temperature than that recommended for any high temperature alloy.

Precautions should be taken to prevent damage to the recuperator, in case of failure of the air supply.

This can be done by having a gas cut-off valve which automatically shuts off the gas when the air supply fails, and there should be a damper between the recuperator and furnace chamber.

It is obvious that should such a failure occur while the recuperator is in the flue gas circuit, the heating elements would ultimately attain the temperature of the flue gases, and this temperature might be excessive.

In applying highly preheated air to gas burners, it is generally advisable that the mixture shall occur close to the burner tip. Air preheated to more than 700° F. should not be applied to furnaces where the gas and air are premixed at some distance from the burner. If preheated air at any temperature is applied to apparatus which automatically mixes the gas and air in correct proportions, a compensating device should be incorporated to make allowance for the increased volume of the hot air.

Recuperators should not be applied to increase the combustion efficiency of badly designed gas burner systems until everything possible has been done with regulation of the gas and air fed to the burners.

Too often they are used merely for preheating the air in order to obtain higher flame temperatures than would otherwise be possible. Modern non-recuperative furnaces, fitted with automatic proportioning burners, will often give better fuel economy than these badly designed recuperative furnaces.

For intermittently operated furnaces it is better to rely on the correct proportioning of the air-gas mixture to achieve fuel economy rather than on a recuperative furnace which has a large heat capacity. For large furnaces working at high temperature a recuperator is a necessary investment, but no appreciable advantage can be gained by its use on a small furnace consuming only small quantities of gas.

Preheating the Material being Treated.

The next method of combatting waste in the flue gases is by using them to preheat the material being treated, the gases flowing in a counter direction to the material. The cold incoming material extracts the residual heat from the cooling waste gases and the material is brought gradually up to temperature as it moves through the furnace.

This method of heat saving has been used for many years in steelworks for the continuous billet furnaces, which discharge the steel at a temperature of 2,200° F. and at the same time have a flue gas temperature often below 1,200° F.

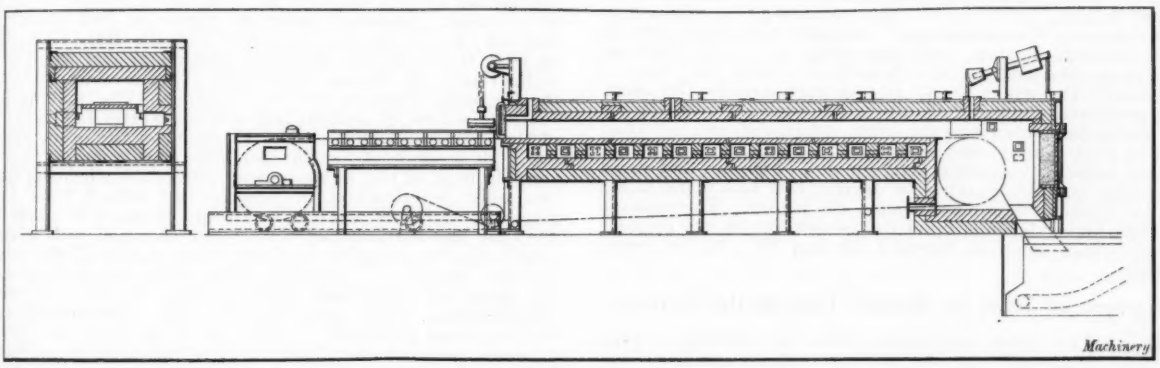
There are many types of continuous furnaces designed as heat interchangers, such as vertical shaft kilns, pottery and cement kilns, together with most types of belt-conveyor furnaces. The employment of waste gases to preheat the material is not confined to large continuous furnaces, but can be applied in many small furnaces by the use of preheating chambers.

Many Batch type forge furnaces are now made with two chambers, so that steel may be preheated in one chamber by the waste gases coming from the other. The double-handling of the work is more than compensated for by the low gas consumption. Another type of double forge furnace has burners in both chambers, only one set being operated at a time.

Each chamber is alternately used for preheating, and this arrangement has the advantage that no double-handling of the steel is necessary. Another benefit obtained is that both chambers may be operated together at full temperature, thereby practically doubling the ordinary rate of production.

In the hardening of high-speed steel it is necessary for the material to be preheated to a temperature of about 900° C. (1,640° F.) before it is placed in the high-temperature chamber at 1,350° C. This is accomplished in the familiar double oven furnace; the upper chamber utilizing the waste heat from the lower to preheat the steel. In this particular design the hearth area of the upper compartment is 40% greater than the lower.

The rates of heat transfer are low at low temperatures, and therefore by keeping the material in the upper chamber for a long time the risk of cracking the steel when it is placed in the high-temperature oven is reduced. This benefit is, of course, additional to that of fuel economy. Similar types of preheating chambers can be used in conjunction with cyanide and lead hardening baths.



CONTINUOUS BELT CONVEYOR FURNACE.

This type of furnace is used for the heat treatment of small articles such as screws, nuts, or chain links. The material is charged on to a flexible metal belt which moves through the furnace at speed that is adjustable to suit the material handled. The only manual labour required is that involved in charging the material on to the conveyor belt. The discharge drum is shown inside the furnace, and the discharge chute sealed in the quench tank. The conveyor, however, returns to the charge end outside the furnace.

Wire annealing, non-ferrous open hearth, and crucible melting furnaces can also be arranged so that the material is preheated by what would be otherwise waste gases. Tests taken in a brass foundry have shown that without preheating the average gas consumption was about 9 c.ft. per lb. of metal melted. When chambers for preheating the metal were incorporated the gas consumption was reduced to below 6 c.ft. per lb.

Use of Waste Heat for Other Operations.

Another effective means of recovering waste heat is to use the waste gases from one heating operation for an entirely different process. Surplus heat may in some factories be utilized for drying purposes, either with or without the aid of an air heater.

In the ceramic industries every intermittent kiln, whether for brick, fireclay, or pottery, is an available source of surplus heat. Drying rooms may often be heated by means of hot air from adjoining kilns when these are cooling down.

Hot air obtained in this manner will give rapid and uniform drying without any expenditure on fuel. Drying plants are in operation in the ceramic industry which are recovering and utilizing nearly two million B.Th.U. per hour, equivalent to a saving of 15 tons of coal a week in continuous operation.

Waste products of combustion from gas-heated galvaniz-

ing baths can be used for drying the articles after the pickling operation before they are immersed in the molten zinc. This drying also gives the benefit that dangerous spattering of molten zinc when the article is immersed is avoided.

One of the first town gas-heated galvanizing installations in this country incorporated drying pans heated by waste gases.

A refractory-lined flue below floor level connected the galvanizing setting with a set of three cast-iron drying pans, each 3 ft. by 3 ft., on which the fittings were thoroughly dried. Auxiliary gas burners were provided under the pans in order to cope expediently with heavy loads. The generation of steam or heating of water in a waste-heat boiler is a special form of heat salvage which makes high thermal efficiencies possible, as the temperature of the flue gases is often reduced to below 500° F.

Although this form of saving has been used for many years in gas-works and some steel works forge plants, it has not generally received the attention it deserves.

In many factories there are processes, such as pickling and cleaning, requiring large quantities of hot water or steam, which might easily be supplied by boilers, working in conjunction with gas-heated furnaces. The practicability of these schemes depends upon both economics and the load factor on the boiler, considered with that of the furnace supplying the waste gases. To overcome the disadvantage of variation in the waste gases, the boiler could be fitted with auxiliary gas burners and automatic controllers.

Recirculation of Flue Gases.

As distinct from direct salvage methods, the recirculation of heat offers a means of lowering the gas consumption of many appliances working at temperatures below 1,200° F.

At present " recirculation " is most frequently used in core baking, drying, and japanning ovens to increase drying speeds, and only incidentally to reduce fuel costs.

Usually the gas is burnt in a heater outside the oven, the products of consumption together with the recirculated air being conducted into the oven, exhausted, and returned to the heater again and again. It is necessary to exhaust to the outside atmosphere only enough of the air and gases to insure complete baking or drying, this loss being made up by fresh air drawn in through the heater. The amount of heat saved depends upon the percentage of gas recirculated, which may be between 50 and 80% of the total volume.

Recovery of Heat in Material Leaving the Furnace.

One of the least appreciated ways of salvage is that possible from the material leaving high-temperature furnaces. When large quantities of material are left to cool, recovery of heat is feasible, and wherever possible should be attempted.

In many cases the heat contained in the product is altogether lost, as in melting of metals where heat is required in the metal to maintain its molten state. However, for such operations as carburizing, enamel coating, pottery glazing, or annealing, it is possible to design counterflow furnaces of the pusher or conveyor types. In counterflow furnaces material enters at opposite ends at room temperature, the high-temperature zone being in the centre with combination preheat and cooling zones on either side. While one row moves through one side of the furnace, another moves in the opposite direction on the other side, the outgoing product at each end transferring its heat to the incoming cold material. The heat recovery depends upon the time in the heat exchange zones and the temperature difference between the two rows of material. In addition to fuel economy, this type of furnace gives a slow, uniform heating up and cooling down of the work, which is often an advantage. Of course, it is not possible to use the flue gases to preheat the incoming work, since they would also heat the work being cooled. The flue gases, therefore, leave the high-temperature zone at a temprature equal to, or a trifle greater than, the furnace temperature. The waste gases can then be passed through recuperators further to increase the furnace efficiency.

Continuous box-type carburizing furnaces have been built which operate at 1,650° F. in the high-temperature zone with boxes discharged from the heat exchange zones at temperatures below 900° F.

Fuel Saving Through Design and Operating Conditions.

The design of a furnace is a big factor in fuel conservation, and continuous working with a uniform load is also an essential requirement. Many types of continuous furnaces have been designed, each suitable for a particular class of work, and these range from the ordinary pusher to the more complicated walking beam, roller hearth, and belt conveyor types.

The latter was developed primarily for the heat treatment of small parts, and its characteristic feature is the continuous belt. In the early designs the heat-resisting steel belt passed through the heating zone and returned on the outside of the furnace casing, thereby wasting heat. The discharge drum was outside the furnace so that the articles being heat-treated came in contact with cold air before being quenched and were badly oxidized.

A natural development of the principle of this furnace was one that would allow of quenching or discharging of the material being treated without loss of temperature. This was achieved by enclosing the discharge drum of the conveyor inside the furnace and sealing the discharge chute in the quenching liquid. A further interesting development is the total enclosure of the entire conveyor within the heating chamber, thereby avoiding the previous loss of heat and distortion of the mechanism through alternate heating and cooling.

A very important factor in fuel economy is the maintenance of the correct temperature demanded by the heating process. Even though furnaces are of the most modern type, there are few cases where loss of heat does not occur through manual control. Skilled furnace operators will turn down the fuel supply as soon as the temperature approaches the desired point, but this does not prevent the tendency to run over the correct temperature, due to the heat stored in the brickwork. Likewise, when cooling down the temperature may fall below that required. It is therefore desirable to employ automatic controlling instruments to regulate the temperature wherever possible if fuel economy is to be realized.

Often the reduction in fuel is secondary to other advantages, such as reduction in labour and time, uniformity, and better quality of work treated, all of which revert to fuel saving. Another important factor in fuel conservation which is frequently overlooked is the time necessary to heat the material. For any given material there is a critical rate of heating which gives the minimum values for the total losses in the heat balance. The soaking for too long a time of heat-treated articles wastes fuel because of the excessive radiation losses, while, on the other hand, too high a speed of heating produces excessive loss in the sensible heat in the waste gases. The correct heating rate can only be obtained in practice by actual tests and research, and only after this can any changes be made in the time and temperature conditions. A paper such as this would not be complete without a discussion of the need for fuel economy. Manufacturers using cheap fuels are not generally concerned with possible savings on small installations. Town gas is not as a rule a cheap fuel, and its increasing popularity is due, not to its price per therm (though there are exceptions), but to the obvious and well-known advantages which usually accompany its application. Frequently it forms a major item of expense in production. Even in small furnaces the cost cannot be disregarded, and therefore every effort should be made to see that it is burned in the most economical manner possible. To this end the more widespread knowledge and application of heat-saving devices is an excellent means.

The industrial applications of electricity are being extended very rapidly, and to combat this competition gas salesmen should induce manufacturers to heat by gas, not by selling them the cheapest appliances, but the best and most efficient.

Discussion.

Mr. A. J. CRUISE (Cardiff) said he was interested in the Rabate Furnace for autoplates. His experience was that it showed a saving.

Mr. B. J. BELL (Cardiff) remarked that methods of heat treatment to-day were very much changed and figures for consumption had improved over those of 20 years ago. He maintained that the Gas Industry should have fully-qualified men in charge of industrial work. He asked what type of burners could be used instead of oil burners for frit melting.

Mr. LEONARD replied that diffusion or long luminous flame burners could be used. These gave radiation from flame instead of from furnace walls.

Mr. BELL then asked what was Mr. Leonard's experience of large water-heating installations using conversion burners applied to existing boilers.

Mr. LEONARD said it was quite satisfactory to apply a gas burner to existing boilers, and generally a system of refractory baffles was built in the furnaces to give longer travel of hot gases than would normally be the case; efficiencies of 70% to 80% were common.

Mr. HOWELLS wanted to know if Mr. Leonard thought recuperators more efficient than a system which preheated the material with the waste gases.

Mr. LEONARD replied that it depended upon the type of furnace and, in general, it seemed preferable to use waste gases to preheating the material.

Long-Distance Gas Distribution in Germany

by
Dr. FRITZ GUMMERT

In the following Paper, presented to the Yorkshire Junior Gas Association at Sheffield on Jan. 19, Dr. Fritz Gummert, Director of the Ruhr Gas Company, gives details of outstanding interest regarding his Company's operations in long-distance gas transmission in Germany.

If I venture to speak in England—the classic or pioneer country of gas manufacture and of its application—on the subject of gas supply over long distances in Germany, it appears to me to be necessary, first of all, to point out some of the important fundamental differences between the two countries; since, from these, it becomes apparent why the development of the Industry in the one country took a somewhat different path from that which was followed in the other.

Without doubt, the most important event in the world's history during the last century was the very extraordinary increase in the population. In spite of emigration to the United States of America and elsewhere, the population of Europe has increased, in round figures, from 180 to 450 millions. Such an increase would not be conceivable without technical progress in all branches of industry, so that sometimes one hardly knows if the increase in the population was the cause or the result of this advance in technical methods. On the other hand, these technical advances would not have been feasible had we not had the good fortune to have at our disposal, in the earth, those stores of solar energy which have been accumulated from early times—namely, those decayed vegetable, and probably also animal, remains existing from a period dating back millions of years. I am, of course, referring to coal and oil. The age of oil has scarcely yet begun; moreover England, that is the mother country, as far as I know, has no oil, and Germany has only a little. Therefore there are, neither in this country nor in Germany, those abundant sources of natural gas such as exist in the United States of America; so that, with regard to gas in Europe, we are concerned with coal gas and, above all, with gas from bituminous coal, since the economic manufacture of gas from brown coal is not yet possible.

Let me first of all cast a glance upon the coal situation in England and in Germany, which countries occupy, respectively, second and third places in the order of the world's coal production. At the present time, between them, they produce roundly one third of the world's output of coal, another third being produced by the United States of America, while the remaining third is the joint production of all remaining countries.

Since 1860, the coal production of Great Britain, then amounting to 80 million tons, has increased threefold, while the then 12 million tons output of Germany has increased by more than ten times. In recent years, the German output, reckoned simply in tons, has, in fact, surpassed that of England; but this figure includes the tonnage of the less valuable brown coal which amounts to more than half the German tonnage. When price is taken as a basis, the English output was some 30% greater than that of Germany; in this connection it may be pointed out that Great Britain has, in round figures, a population of 50 millions and Germany one of 65 millions.

The situation is, however, different as far as coke is concerned. The output of coke from gas-works amounted latterly, in Great Britain, to three times that of Germany; on the other hand, the German output of coke, from colliery coke ovens, was three times that of England. This factor is of very great importance in reviewing the question of the supply of gas over long distances. The greater quantity of coke made at the German collieries is due chiefly to two reasons:

(1) The production of pig iron, in normal years, is considerably greater in Germany than in England; consequently, the consumption of blast furnace coke is greater in the former country.
(2) Coal mining in Germany involves a greater production of small coal than it does in England. This slack can only be stored or transported with difficulty, and it is therefore more economical to convert it into coke.

Adding together the output of gas-works coke and blast furnace coke, Germany produces about one third more than does Great Britain. This figure is also approximately correct for the make of gas, if calculations are made according to gas produced and not according to gas used, which distinction must be particularly emphasized.

An Important Difference.

A further important difference in the coal position of the two countries is evident from the fact that while in Great Britain coal production is widespread throughout the country, in Germany, on the other hand, it occurs less frequently—namely, in the Ruhr, in Silesia, in the Saar, and near Aix-la-Chapelle. Of these areas, the Ruhr is by far the most important, since it produces 70 to 80% of the total German output. Within the Ruhr coalfield there are some 50 different collieries, but three-quarters of the Ruhr coal output is supplied by 12 undertakings only; and, in point of fact, one quarter of the output is the product of one concern. The majority of these undertakings are not primarily collieries, but iron and steel works. All collieries in the Ruhr coalfield are members of the Rhenish-Westphalian Coal Syndicate, which body controls, from one centre, all sales of coal. Owing to these circumstances, the production of coal in Germany and the chief manufacturing centres for coke and for coal gas have grouped themselves at a few central points in the country. The principal function of a gas-works is to produce gas, and from this standpoint, coke, in spite of its value, is but a bye-product. In an exactly similar way the coke ovens make coke as their primary product, and blast furnace coke at that, so that, to them, gas becomes a bye-product.

Owing to the continual advances which are being made in the design of coke ovens, an improvement in the quality of the coke made goes hand-in-hand with an increased yield of gas. In the years of prosperity, the make of coke oven gas at the Ruhr Collieries was close on 10,000 million cub.m., or 353,200 million c.ft., but in the year 1933 this was about 6,000 million cub.m., or 211,920 million c.ft. By way of comparison, the gas made at the German gas-works was some 3,000 million cub.m., or 105,960 million c.ft., and that by the gas-works in Great Britain some 9,000 million cub.m., or 317,880 million c.ft.

What became of this gas before its distribution over long distances was inaugurated? About 45% of the make of coke oven gas was used for heating the coke ovens, a further 45% was used for steam-raising at the collieries, and only 10% was otherwise employed—that is to say, it was either supplied to neighbouring ironworks for the generation of electricity, or sold, after purification, to local authorities.

I should like to interpose here that no difference whatever in quality exists between the purified coke oven gas and that manufactured by gas-works. A very small portion of the gas referred to above was indeed burnt to waste on Sundays, because no good use could be found for it.

Economic Idiocy.

The consumption of gas, which is the purest product the coal industry can supply, for the purpose of firing steam boilers, or for heating coke ovens, was economic idiocy. This stupidity was particularly great in the case of the so-called "grading problem." In addition to the easily sold lump coal and the slack suitable for coke making, the collieries had for disposal certain coal refuse—duff for example—from the coal washeries and so on. The coal had from time to time to be stored, but during such periods the gas was burnt. It became essential, therefore, to effect a rearrangement of this procedure in such a way that the low quality coals were used for steam-raising under the colliery boilers while the gas was sold.

At about approximately the same time at which these ideas became current, improvements were made in the manufacture of pipes and in methods of joining them by

welding. Considerable experience had been accumulated from the long mains used for the transport of natural gas in the United States of America, so that there was no need to view with concern the conveyance of coke oven gas over long distances. This latter procedure was essential, because, in the relatively small area of the Ruhr, there did not exist sufficient possibilities for the disposal of the enormous quantities of gas which were available.

The utilization of the gas on a large scale could, however, only be carried out if the various collieries co-operated for this purpose; since it would have been too costly, and, in addition, foolish, had each individual colliery laid its own mains to distant consumers. This co-operation was rendered all the easier by the fact that, in the Rhenish-Westphalian Coal Syndicate, such fusion had already taken place. In the years immediately following the war, with their dangers of socialization and the French occupation of the Ruhr, together with Germany's economic collapse, such a large scale undertaking could not be thought of. Only in 1924 and 1925, when German industry had begun to settle down after the upheavals of the war, and of the post-war periods, was such a project possible. It was carried through by Germany's insistent desire that her productive undertakings, which had suffered severely during the war, should be brought to such a state that she could compete in the world's markets, and thereby attempt to enable herself to bear the burdens laid upon her by the so-called Treaty of Versailles.

Such an undertaking was also assisted by the fact that, as a result of the war, the United States of America had been converted from a debtor to a creditor nation which was anxious to make profitable use of the gold which had flowed into her coffers. In spite of this, it was essential to have available, with the initiative and the power to convince others, a man accustomed to thinking on a large scale in order to overcome the opposition, the lethargy, and the difficulties which lay before such an undertaking.

Foundation of the Ruhr Gas Company.

This man was Managing Director Dr. Alfred Pott, who succeeded in founding the Ruhr Gas Company, Ltd., in 1926, in which Company nearly all the Ruhr collieries are shareholders. I have already mentioned that certain towns, situated in the Ruhr Coalfield, had shut down their gas-works and were taking supplies of coke oven gas. In this way, the supply of gas on the grid system was already in operation over a distance of some 186 miles, through relatively small diameter mains, to a line of towns in the hilly country to the south of the Ruhr, principally to Remscheid, Solingen, and Barmen. This grid was laid by the Rhenish-Westphalian Electricity Company in 1912, in conjunction with the Thyssen Gas and Water Works Company, Ltd. This grid of the Rhenish-Westphalian Electricity Company was acquired by the Ruhr Gas Company in 1928, and at the same time an agreement was made between the Ruhr Gas Company and the Thyssen Gas and Water Works Company for friendly co-operation.

A portion of the mains, which will be referred to later, is in the joint possession of the Thyssen Gas and Water Works Company and the Ruhr Gas Company. The Thyssen Gas and Water Company utilize exclusively coke oven gas from collieries, which are situated in the Ruhr area and also in the Aix-la-Chapelle Coalfield, to which latter area Thyssen has laid a main. They sell gas in exactly the same way as does the Ruhr Gas Company, so that the only difference between the two Companies lies in the quantity of gas sold by each of them. I can, therefore, limit myself, in the following remarks, to a description of the history of the Ruhr Gas Company.

The years 1926, 1927, and 1928 were devoted to preparatory work. Agreements were made with all our shareholding companies, which were supplying gas, whereby the Ruhr Gas Company became entitled to dispose of all their surplus gas. These agreements ensured that none of these shareholding companies would be able to enter into competition with the Ruhr Gas Company. The capital of the Ruhr Gas Company was fixed at 25 million Reichsmarks, but this was later increased to 27 million Reichsmarks. This capital is exclusively in the hands of the members of the Coal Syndicate and cannot be disposed of in the open market. In addition to this, a loan of 12 million dollars was raised in America.

The purchase of the above-mentioned Gas Grid from the Rhenish-Westphalian Electricity Company signalized the bringing into operation of the agreements made by the Ruhr Gas Company with the respective collieries, who were also its shareholders.

The first small mains of the Ruhr Gas Company were ready at the end of 1927, and connections to the first consumers were made at that time. During the next few years the first of the projected Gas Grids was constructed, and in 1931 the principal mains were completed. In the subsequent years, up to the present time, only small portions were added to the Grid, chiefly in order to connect consumers. To-day the Gas Grid has, in round figures, 948 kilometres, or 589 miles, of mains in operation. Of these mains, 251·6 kilometres, or 156 miles, have a diameter of 300 millimetres, or almost 12 in., or more, 387 kilometres, or 240 miles, have a diameter of 500 millimetres, or almost 20 in., or more, and 47·3 kilometres, or 29 miles, have a diameter of 800 millimetres, or 31½ in.

The greatest existing extent of the Grid from West to East, that is to say approximately from Cologne to Hanover is about 250 kilometres or 155 miles; which is a distance almost equal to that from London to Sheffield. The length of the Grid from North to South is somewhat less. The diameter of the mains was, of course, so selected that they are not only capable of passing exactly the expected quantities of gas, but room is left for subsequent increases on the basis that streets—and after all the mains are merely these—themselves attract and create traffic once they are in existence.

Pipework.

With the exception of the earlier Rhenish-Westphalian Electricity Company's Grid, in parts of which cast-iron pipes are still used, all pipes throughout are made of wrought iron and a small number of these is seamless (especially where the diameter is less than 400 millimetres, or nearly 16 in.), the joints being welded by the oxy-hydrogen flame. As I have already mentioned, the main section of the Grid was completed in three years; this work was done, in part, by a subsidiary company of ours, founded specially for the purpose, and in part by contractors under our supervision.

The Ruhr Gas Company is an entirely private undertaking, and the Government plays no part in it. We have, however, quite voluntarily, elected a number of mayors and other highly placed local officials to our Board. We only seek Government assistance during the laying of the mains for the purpose of acquiring compulsory powers to perform this work, on the basis that such a service is in the public interest. When we have acquired compulsory powers, which up to the present we have always succeeded in obtaining, negotiations are opened with the individual property owners in order, if at all possible, to obtain mutual agreement. This is usually successful except in a few cases in which the compensation for the use of the ground has to be fixed by the Government's representative, and which he generally bases upon the voluntary offers made by us. The compensation paid depends upon the value of the ground in question. There is, for example, a distinction made between building-ground, plough-land, and meadow-land.

At first, we had difficulty with the State Railway, which, as a public utility undertaking, can only be deprived of its rights under conditions which are but reluctantly conceded. The Railway at first looked upon us as competitors, in the belief that it would lose considerable coal transport as the result of our long-distance mains. Gradually, however, other and more correct views prevailed. The supply of a cheap and technically ideal fuel brought certain industries, which are situated relatively remotely in the countryside, into the same favourable geographical position as those which lay within the coalfield. In this way the supply of gas over long distances opposed the tendency—otherwise unrecognized—which confined the smaller industries to the country or to small towns, and gathered the major industries in the larger towns of the Ruhr area.

This concentration of large industries had, however, brought in its train much greater difficulties for the Railway, owing to the lack of transport facilities, than did the long distance supply of gas, which latter enabled the small local industries in country districts to carry on. This, at the same time, brought with it a political advantage in that the local peasantry, the majority of whom were smallholders, were enabled to live more contentedly than did the working population of the large towns who had been uprooted from their rural surroundings.

It has been proclaimed that the long-distance supply of gas was the saviour of the Lennethal industry—that is to say, of the many small works which had established themselves in that district in the 19th century, on account of the small outcrop of iron and the water power which was available there. The majority of them could not have survived without the reduction in the cost of fuel and the improved quality of their products which long-distance gas enabled them to achieve.

As the result of these considerations, we have been able to conclude a general arrangement with the Railway by which we are allowed to cross railway lines, without obstruction or delay, upon payment of a fixed consideration.

Mainlaying Difficulties.

The laying of the mains was not always simple; sometimes we encountered difficult rocky sections, especially in the Lennethal hills, and on the Hanover section we were troubled by water. Frequently, the mains had to be laid through rivers, one of which was the Rhine; only at a few places could we utilize bridges. Railway embankments had to be pierced, and for this purpose special machinery was designed which, even in the case of wide embankments, forced a shield pipe by hydraulic rams through the embankment; subsequently the main itself was laid through the protecting pipe. Certain difficulties were caused in the relatively congested mining area of the Ruhr by the effects of mining operations, and here it was necessary to incorporate an expansion joint every 80 metres, whereas, on other sections such joints were placed 150 metres apart.

The length of the individual pipes varied from 8 to 16 metres. The joints between the individual pipes were made by autogenous welding; we are experimenting with electric welding at the present moment, but the experiments are not yet concluded. In order to reduce the amount of welding on open sections of the line, two 8-metre lengths of pipe were joined, at the pipe works, into one length of 16 metres, by oxy-hydrogen welding.

On certain sections of the line, pipes to a length of about 100 metres are welded together above ground, subjected to a pressure test, and then laid in the trench. This method has the advantage that road traffic is obstructed as little as possible and that welding in the trench is reduced to a minimum. The ends of each pipe are so formed that a change of direction up to 6° is possible without the use of special bends. On an average, the cover is about 80 centimetres, or 31½ in. thick.

At first the pipeline was laid in the existing streets or in the ditches bordering country roads, but subsequently the tendency to lay the mains in the open country began to develop. Each pipe was covered with a protective wrapping at the works where it was made, which works were also shareholders in our Company. For this purpose felt wrapping was chiefly used. The joints were wrapped by separate pieces. We pay special attention to the protection of the mains against corrosion, in particular that caused by electrical wander-currents which emanate more especially from electric tramway systems which, in the Ruhr area, are very numerous, and are all interconnected. An electrical method has been evolved by which such danger areas can be located without excavation. I might mention here that in making allowances for depreciation we are counting on a life of 30 years for the mains.

A Factor of Advantage.

A factor which was of particular advantage to the supply of gas over long distances was one which I have already mentioned—namely, that only a relatively small number of collieries could be considered for this purpose. Equally favourable was the circumstance that the number of coking plants, which amounted to about 125 in 1925, and which had become obsolete during the war and the French occupation, had been reduced very considerably when the new centralized coking plants were put down at the collieries; so that, for practical purposes, only about forty large-scale plants came into question.

In 1928 we were connected by mains with eight of these, in 1929 with 15 of them, and now in 1934 we take gas from thirty. Certain of these coking plants, in which the ovens are 6 metres, or 19½ ft., high and 13 metres, or 42 ft., long, can produce from 300 to 400 million cub.m., or 10,596 to 14,128 million c.ft., per year.

The gas is purified and compressed at the collieries. The removal of hydrogen-sulphide is effected chiefly by dry methods, using bog iron ore. However, to-day, new methods of doing this are being subjected to practical trial. For the removal of naphthalene, a special method of washing, using wash oil in conjunction with cooling the compressed gas to a low temperature, is employed. Compression usually takes place by pump type compressors coupled to reciprocating steam engines. The pressure varies considerably. The lowest pressure is employed in small special mains leading direct from the collieries to consumers in the vicinity, and it is greater in the large long-distance mains.

At the present time pressures of 3 to 5 atmospheres, or 44 to 73½ lbs., per sq. in. are employed; the mains are however capable of withstanding considerably higher pressures of from 10 to 15 atmospheres, or 147 to 220 lbs., per sq. in. It may later prove necessary, with the increased quantities of gas, to erect intermediate compressing stations. Exact data are available as to the optimum pressure which can be used in relation to the diameters of the pipes and to the cost of compression. Generally speaking, over short distances the correct practice is to use large diameter pipes and low pressures, whereas, over long distances, higher pressures and smaller diameters are the rule. According to investigations which we have made, pressures of 30 atmospheres, or 441 lbs., per sq. in. can be used without producing any condensation of the gas.

The calorific value of the gas supplied by us averages a maximum value of 4,600 kilogram calories, or 517 B.Th.U., per c.ft. This is somewhat higher than that of the gas from the German gas-works. The type of coke oven used and also the needs of the various iron works are such as to lay special stress upon the calorific value of the gas exceeding a minimum of 4,000 kilogram calories, or 449 B.Th.U. In the case of smaller consumers, the gas is measured by drum type meters; but at the collieries and for large consumers a meter is used in which the speed of the gas is the operating principle.

Supervision of Distribution.

The supervision of the distribution is rendered easier because, in nearly all cases, cables are laid with the mains, by means of which distant meters register quantity, pressure, calorific value, and density, which figures are recorded in a central station in the offices of the Ruhr Gas Company. From this control room the whole of the gas supply is regulated as from the captain's bridge on a ship, and from this point specific instructions are sent to the colliery coking plants.

I have already stated that the coke oven plants are not operated for the manufacture of gas. We are therefore unable to say to them: "To-morrow morning we shall need so many cubic metres of gas, so please arrange for your production accordingly." Our consumption can always be only a portion of that which the coke ovens must produce in turning out their output of coke. Sometimes we take more gas from the collieries and sometimes less. This creates certain difficulties for the coke oven management which are solved in the following way.

If all the available gas is being taken by us, then the collieries revert to coal slack for steam raising; if, on the other hand, we require only small quantities of gas, then the surplus is used for steam generation. In this way a singular elasticity is attained in the disposal of the gas. For the maintenance of the Grid, breakdown gangs are distributed over the system, and, in addition, the mains are regularly patrolled. In order to locate leaks, the expansion joints, when situated in built-up areas, are fitted with pipes which enable tests to be made by smell, and such pipes are also fitted to the welded jointing pieces. The breakdown gangs are in direct telephonic communication with the Control Room, and section telephones are situated along the pipelines.

In order to attain further flexibility of supply, the Ruhr Gas Company has at its disposal at the present time four gasholders of its own and two which belong to collieries. These have a total capacity in round figures of 900,000 cub.m., or 31,788,000 c.ft. These large holders are, of course, of the waterless type, and by their aid large variations in consumption can be successfully dealt with. Another gasholder of no inconsiderable volume is provided by the mains themselves, which can be considered to be a form of high-pressure storage.

Seasonal variations in consumption scarcely play any part in our undertaking, because, up to the present, the increase in consumption has overshadowed such changes and moreover such variations have a smaller incidence upon the industrial load than they have upon the domestic. As a whole, with us in Germany, the municipalities have a winter peak load. However, in towns supplied with gas from a distance a tendency has been noticed towards an increase in this peak load, since the necessity for the disposal of the coke does not exist in towns supplied with gas from a distance, and therefore many consumers are recruited for gas heating. On the other hand, a factor which tends to diminish the winter peak load is the fact that, at this season, many households use coal in the kitchen ranges, whereas in summer they cook by gas. The daily variations are very much greater than the seasonal. The following are the figures for a typical week:

Sunday	1·8	million	cub.m.,	or	63½	million c.ft.
Monday	4·2	,,	,,	,,	148½	,, ,,
Tuesday	4·4	,,	,,	,,	155½	,, ,,
Wednesday	4·6	,,	,,	,,	162½	,, ,,
Thursday	4·7	,,	,,	,,	166	,, ,,
Friday	4·5	,,	,,	,,	159	,, ,,
Saturday	3·6	,,	,,	,,	127	,, ,,

Equalizing Variations in Industrial Demand.

We endeavour, as far as we are able, to equalize these variations caused by the industrial demand. The hourly variations, on the contrary, are relatively small, the cause of which again is the preponderating industrial load. Regarding the daily figures, the peak load, at about 13 o'clock, is only 18 to 20% above the normal, and the mini-

mum consumption, at about 20 o'clock, is 13 to 15% below the normal.

So much for the technical side. The gas disposed of per annum has increased as follows:

1928	. . .	137	million	cub.m.,	or	4,839	million c.ft.
1929	. . .	405	,,	,,	,,	14,305	,, ,,
1930	. . .	718	,,	,,	,,	25,360	,, ,,
1931	. . .	796	,,	,,	,,	28,115	,, ,,
1932	. . .	843	,,	,,	,,	29.775	,, ,,
1933	. . .	1,076	,,	,,	,,	38,004	,, ,,
1934	. . .	1,400	,,	,,	,,	49.448	,, ,,

The critical years, especially after 1930, exerted an unfavourable effect on the increase in consumption as compared with the estimates for these periods. However, in spite of the difficult times, we were able to register an increase for the year. As far as can be foreseen, the increase, from now onwards, will continue only slowly.

At this point, I should like to call your attention to a singular phenomenon, and that is, that with increasing upward fluctuations in trade, the quantity of gas available for our undertaking increases. This is due to the fact that, owing to the lighting up of blast furnaces which were formerly out of action, further quantities of blast furnace gas become available; which gas, in spite of its low calorific value, can be employed for industrial purposes, and the coke oven gas, formerly used in these trades, become available for us.

It is also of interest to note that our calculations of future requirements of gas have subsequently proved to be incorrect. These calculations were based upon, among other things, the cost and the quantities of coal used by industries in certain areas. However, it transpired that, after conversion to gas firing, the quantities of heat which were then saved, owing to the employment of gas permitting greater economy in fuel, were greater than were at first believed to be possible. The advantage to the consumer—that is, the greater cheapness of a given quantity of heat that was estimated for when calculating the quantities of gas required—reacted naturally to the disadvantage of the Ruhr Gas Company.

The Direct Main.

I will now touch upon a peculiarity in connection with the Ruhr Gas Company, which does not occur, at any rate, to a similar extent, in the case of other gas undertakings—that is, the so-called direct main. I have already mentioned that the collieries which supply us with gas are at the same time our shareholders. Only a few of these collieries are collieries pure and simple; by far the greater number of them form part of large iron and steel works. In cases in which the steel works in the Ruhr coalfield are situated in the vicinity of the coke ovens, they take their gas direct from them without the intervention of our Company; but, if the ironworks and the coke ovens are situated at some distance from each other, or, if the ironworks lie right outside the Ruhr coalfield, there was, until now, no possibility of a direct supply to them. Certain of our shareholders have a large number of such works—that is, from 10 to 50—situated outside the coalfield. Now, in cases such as these we do not proceed to buy gas from our shareholder's colliery—say, from a pit owned by the United Steel Company—and sell it again to a consumer—say, for example, a rolling mill in Siegerland—which is also owned by the United Steel Company. But we act merely as transporters for the gas required.

The sale of the gas is a matter entirely between the respective colliery and the iron-works, who are our shareholders, and we are paid only for conveying the gas. The quantities conveyed in this way, and which are included in the gas consumption figures of the Ruhr Gas Company, amount to 50 to 60% of the total. All these amounts of gas are used for industrial purposes, but of the remaining 40 to 50%, the greater portion is also used in industry, and only a relatively small quantity—that is, some 15%—is used by the municipalities. Approximately 40 towns are supplied direct by us, and among these the largest are Cologne, Hanover, Remscheid, Solingen, &c. About 30 more towns are supplied through special distribution companies, which to a certain extent have been formed with public funds in certain areas.

In this way, for example, the Westphalian Long-Distance Gas Company, Ltd., Dortmund, was founded by the towns and rural districts in South Westphalia without the intervention of private capital. This Company obtains its gas exclusively from us and sells it direct, through its own mains, to towns and industrial concerns, the latter taking the greater portion of its output. In the districts served by this and other such companies, we only have the right to supply the works of our shareholders—that is, those directly affiliated to us. Once again I want to emphasize that 85% of the gas delivered by the Ruhr Gas Company is supplied to industrial undertakings and only 15% to municipalities, because I regard this as peculiar to our undertaking, and also to the supply of gas over long distances in Germany.

The allocation of the gas consumed by the various industries is as below:

Industries producing iron, about 33%.
Industries working up iron, about 36%.
Chemical industry, about 10%.
Glass and ceramic industries, about 3%.
Non-ferreous metal, about 2%.
Miscellaneous, about 1%.

I am unable to go into details regarding the ways in which our gas is employed within the various industries.

I will only mention that much has been done in improving the furnaces and the burners, and that, up to now, none of our consumers has abandoned the use of gas. In comparing coal and gas, purely on a price basis, the great advantages of gas cannot be left out of consideration. These comprise the constant readiness of gas for immediate use in any desired quantity; the supply of gas of regular quality under high pressure and the possibility of adjusting exactly the amount of heat required; the small wear and tear of the furnaces; the avoidance of scaling; the elimination of the space necessary for coal storage; and many others.

When compared with the manufacture of producer gas by individual works, our gas has particular advantages, especially when work is carried out only on a few days in the week. Attention may also be drawn to the absence of smoke. A works employing gas for heating purposes has quite a different appearance from one in which coal is used as a fuel, with its attendant clouds of smoke and unhealthy atmosphere. In spite of fierce competition from coal, producer gas, oil, and not least, from electricity, we are continually obtaining new consumers.

Price Grading.

Our prices are variously graded according to our customers; they depend to a large extent upon the quantity of gas taken. We are, however, able to meet customers with specially favourable prices under special circumstances. In order to assist consumers in developing furnaces of the highest efficiency, we have founded a subsidiary company called "Indugas"—that is, "Industrial and Gas Furnace Construction Company, Ltd."—which is engaged in the construction and development of large and small furnaces, burners, &c.

Supply to Municipalities.

Now as to the supply to municipalities. As has been mentioned already, only 15% of our gas is so disposed of. I frankly admit that, when we founded our Company, we believed that towns would utilize our supply to a much greater extent, and more rapidly, than they have done. In order to go more deeply into this question, I must, first of all, lay stress upon a very great difference in the gas supply systems of Great Britain and of Germany. In the latter country, after the gas-works had been built, originally by private enterprise, they were taken over by municipal authorities to a very much greater extent than was the case in England. Only about 10% of the gas-works in Germany still belong to private concerns. It was held to be for the common good that it was the business of the municipalities to supply their inhabitants with gas, water, and electricity.

As the result of continuous progress in technical methods the manufacturing costs of gas have become continually less, but the municipalities have only reduced their prices to a very small extent. They have looked upon the savings much more as a new and very welcome form of taxation, and this is so much so to-day that of the price paid for gas by the newest consumer a great portion—according to my opinion, at least one third—represents a special source of income for the municipalities, which has no foundation in the expense of making the gas, or in that of its distribution through their mains. Consequently, the municipalities, when they take long-distance gas from us, lay the most anxious stress upon retaining its distribution in their own hands. Our undertaking, in every case, supplies gas to the municipal authorities and not to the final consumers.

As the result of this handling of affairs by the municipalities, who rely upon this type of monopoly, and since their rights over their streets can only be circumvented with difficulty, it was a very difficult matter to furnish certain of the larger industrial concerns with a direct supply. On the other hand, the municipalities themselves were not particularly anxious to supply these works with gas, since they could only do so at prices which were considerably below those generally ruling.

For the larger works, and also for the works which were our shareholders, as well as in the case of sundry other

large undertakings the following solution of the problem was discovered. By means of special agreements with these towns they allowed us to supply certain specified works on condition that a portion of the price received for the gas was handed over to them. It is, moreover, always thus—namely, that in order to supply gas, a kind of toll must be paid, which, in the case of all other goods, for example, coal, oil, &c., was abolished in the Middle Ages. When the plans for the supply of gas over long distances came to light there ensued a lively exchange of opinions between the collieries and the municipal representatives. Voluminous petitions and counter-petitions were written and an endless number of memoirs were published. These differences of opinion, above all, had the great political and economic advantage that every effort was made by the municipal gas-works to reduce their manufacturing costs and to increase their output.

Many Arguments.

I cannot enter into the many arguments which were advanced both by the collieries and by the local authorities. The gas-works laid particular emphasis on the advantages of de-centralization in manufacture, and they further asserted that long-distance transmission would endanger the reliability of the supply and that such gas would also be more expensive than that made by the municipalities themselves. The collieries, on the other hand, pointed out the political and economic importance of making good use of quantities of gas already available. They emphasized that to increase the use of gas, by means of a supply from a distance, was much sounder than to do so by increasing the production of the municipal gas-works, because, by the latter method, not only gas but coke, which could only be sold with difficulty, was one of the resultant products.

The collieries further maintained that the formula of the municipalities—that is to say, cost of coal *plus* carbonizing expenses divided by the receipts from the sale of coke and bye-products, equals the cost of gas—gave figures which made the cost of gas too low, more particularly because depreciation was not taken sufficiently into consideration.

The collieries asserted that it was an advantage to have agreements over long periods, which were essential in the case of long-distance supplies, because these resulted in stable prices.

From the opposite standpoint, the municipalities regarded this as an undesirable restraint. They admitted the inefficiency attending a large number of small gas-works, but reached the conclusion that it would be practical to arrange a system of group supply by which the larger towns would supply their smaller neighbours by means of relatively short connecting mains.

Gradually the turbulent spirits became calmer. In spite of all difficulties, of which in later years the greatest was the unemployment caused by the closing of the municipal gas-works, we were able to take over the supply to a number of large and small towns. We are of the opinion that we have not yet come to the last of such difficulties; more especially in cases where a town has to make a decision as to whether it shall put fresh capital into its gas-works or go over to supplies from a distance. Even in the case of towns where the latter is preferred, the mayor, and especially the gas-works directors, even to-day, have no use for long-distance gas supplies.

No Cause for Regret.

I should like to add here that in no case have any of the towns, which have taken long-distance gas, had cause to regret their decisions; they are on the contrary, very satisfied with their supplies. As in the Ruhr coalfield, so in the other German coal mining areas, people have not been idle. In these other areas there are long-distance gas supply systems exactly similar to ours, but on a smaller scale. The Aix-la-Chapelle coalfield has already been connected by a long-distance main with that of the Ruhr and, as far as can be seen, that of the Saar will also be linked up before very long.

In comparison with that of electricity, which within the last 30 years has constructed a large high-tension Grid system over nearly the whole of Germany, the Gas Grid systems are, so far, mere fractions. The question as to whether such fractions, although they give a good return on the capital, will remain as such, or whether they will lead to a long-distance Grid system stretching over the whole country, can only be answered by time. Technically the necessary conditions are in existence—that is, an abundant supply of gas in the coalfields and the feasibility of gas transport through long-distance mains. However, much will depend on the future development of electricity, more especially with regard to the price and to the development of electrical apparatus.

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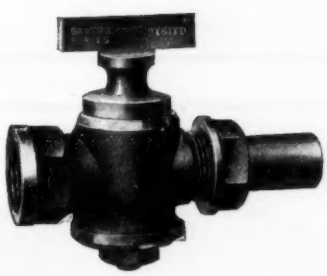

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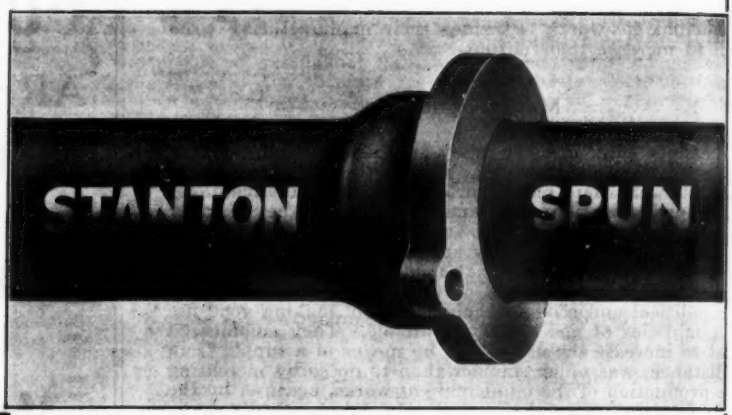

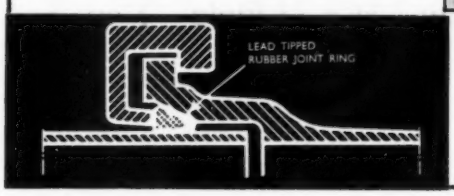

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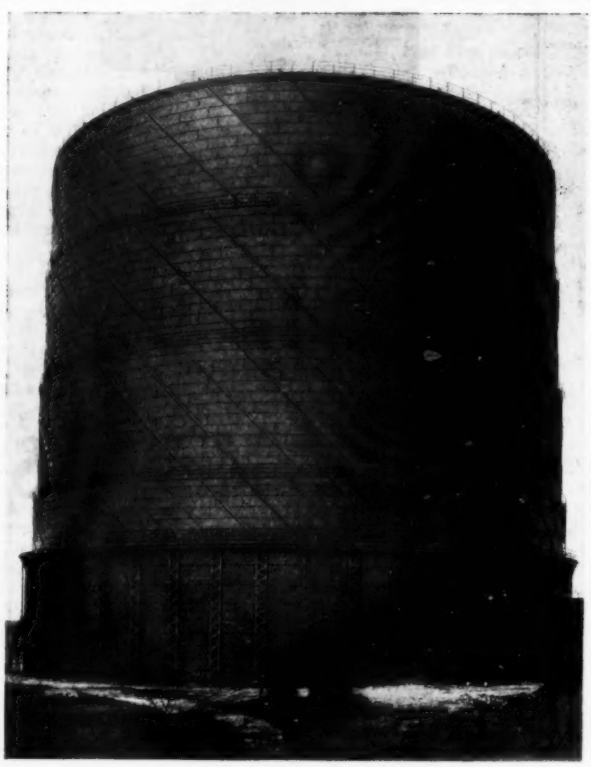

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Gas Markets and Manufactures

Stock Market Report.

[For Stock and Share List, see later page.]

Much excitement was caused for a short while last week by a "panic" on the Foreign Exchange market, brought about by rumours over the possible consequences should the result of the appeal against the "gold clause" be adverse to the American Government. Stock markets, however, remained almost unperturbed, and, though there was a small amount of liquidation, leading to some marking down of prices, support was quickly forthcoming at the lower levels, and in the majority of cases values recovered. British Funds continued to be heavily bought, and nearly all showed improvements on the week. Home rails remained dull and, with the exception of Great Western ordinary, prices fell. There were some bright spots in the Industrial market, especially among motor and tobacco shares, while Triplex Glass made a substantial advance.

The Gas market was again well supported, and a number of stocks were marked up in value. Ordinaries were particularly strong, and in several instances the prices of recorded transactions appeared to justify some appreciation in the quotation, which, however, did not materialize. Nearly all the leading stocks improved, including Gas Light units by 3d. to 28s. 6d. South Metropolitan went ahead again with a further gain of 2 to 151½; South Suburban rose 3 to 149½; and, on the local Exchange, Newcastle units hardened 6d. to 27s. 3d. Some debenture stocks also appreciated, including a sharp rise of 7 to 132½ in Croydon 5%.

The Directors of the Commercial Gas Company are seeking authority at the forthcoming annual general meeting of the Company to raise additional capital. It will be remembered that during the years 1932 and 1933 £298,275 ordinary stock was exchanged for £286,344 new 5% debenture stock, but capital receipts have not been increased since an issue of ordinary stock in 1909.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Jan.* 21.

There is little of interest to report in the tar products market, with current prices at the following levels:

Pitch, 46s. to 48s. per ton f.o.b.

Creosote, not less than 5d.

Refined tar, 4d. to 4½d. per gallon in bulk at makers' works.

Pure toluole, 2s. 2d. to 2s. 3d.; pure benzole, 1s. 9d. to 1s. 10d.; 95/160 solvent naphtha, 1s. 7d.; and 90/160 pyridine, 6s. 3d. to 6s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Jan. 21

The average prices of gas-works products during the week were: Gas-works tar, 20s. 9d. to 25s. 9d. Pitch—East Coast, 45s. to 47s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 45s. to 47s. 6d.* Toluole, naked, North, 1s. 6d. to 1s. 8d. Coal-tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4½d. Heavy naphtha, North, 9¾d. to 10¾d. Creosote, *ex* works, in bulk, North, liquid and salty, 3⅜d. to 3½d.; low gravity, 3⅜d. to 3½d.; Scotland, 3⅜d. to 3⅝d. Heavy oils in bulk, North, 3⅜d. to 4¼d. Carbolic acid, 60's, 1s. 8d. to 1s. 9d. Naphthalene, £10 to £11. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Jan.* 19.

Trading is quite active, but prices do not show any material alteration during the week.

Crude gas-works tar.—Actual value remains at 29s. to 31s. per ton *ex* works in bulk.

Pitch.—Business is practically at a standstill, but makers are still quoting 43s. to 44s. per ton f.o.b. Glasgow for export and 42s. 6d. per ton f.o.r. works in bulk for home trade

Refined tar is being quoted for prompt and forward at 3d. to 3⅛d. per gallon, f.o.r. naked.

Creosote oil.—Prices are well maintained and a fair volume of business is being fixed for prompt and forward. B.E.S.A. Specification, 4¼d. to 4½d. per gallon; low gravity, 4¼d. to 4¾d. per gallon; and neutral oil, 4¼d. to 4½d. per gallon; all f.o.r. in bulk.

Cresylic acid.—It is anticipated in some quarters that cresylic will improve in sympathy with creosote. Meantime quotations are steady. Pale, 97/99%, 1s. 3d. to 1s. 4d. per gallon; dark, 97/99%, 1s. 1d. to 1s. 2d. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 5d. per gallon; all *ex* works.

Crude naphtha.—Available supplies command 4d. to 4½d. per gallon, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 3d. to 1s. 4d. per gallon, and 90/190 heavy is about 9d. per gallon.

Motor benzole is quoted at round 1s. 3d. to 1s. 4d. per gallon for reasonable quantities.

Pyridine.—90/160 grade is 6s. to 6s. 6d. per gallon, and 90/140 grade 6s. 6d. to 7s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

		s.	d.		s.	d.	
Crude benzole		0	9	to	0	9½	per gallon at works
Motor	,,	1	3½	,,	1	4	,, ,, ,,
90%	,,	1	4	,,	1	4½	,, ,, ,,
Pure	,,	1	7½	,,	1	8	,, ,, ,,

Trade Notes.

Analyses of Coals and Coke.

We have received from Messrs. Dorman, Long, & Co., Ltd., Zetland Road, Middlesbrough, a copy of their attractive booklet giving analyses of their Durham coals and coke and information regarding the Company's modern methods of coal and coke handling.

Contracts Advertised To-Day.

Asbestos Goods, &c.
Salford Gas Department. [p. 212.]

Coal.
Clacton-on-Sea Gas Department. [p. 212.]
Salford Gas Department. [p. 212.]

Controllers for Public Lamps.
Prestwich Urban District Council. [p. 212.]

General Stores.
Nottingham Corporation. [p. 212.]

Glassware.
Salford Gas Department. [p. 212.]

Lamp Columns.
Prestwich Urban District Council. [p. 212.]

Lamps (Street).
Prestwich Urban District Council. [p. 212.]

Machine Tools, &c.
Salford Gas Department. [p. 212.]

Pipes.
Stockton-on-Tees Gas Department. [p. 212.]

Refractory Materials.
Salford Gas Department. [p. 212.]

Tar.
Slough Gas and Coke Company. [p. 212.]

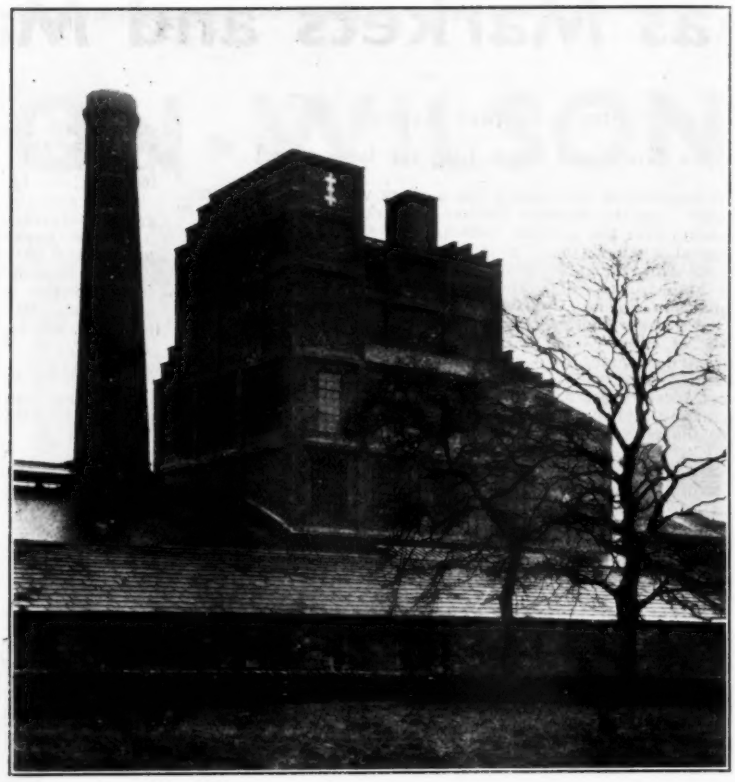
Tar, Pitch, and Creosote Oil.
Nottingham Corporation. [p. 212.]

Town Gas from Brown Coal.

Reviewing the difficulties attending the production of town gas from brown coal, in its naturally moist state, the *Deutsche Bergwerks Zeitung* reports that the experience of the electricity works in Essen and Düsseldorf with the Schmidt process indicates that considerable progress has been made, inasmuch as all the tar is transformed into valuable light hydrocarbons, there is no low-temperature coke (which was difficult to market), the whole of the carbon in the semi-coke being transformed into water gas, with the aid of the moisture present in the raw coal, while, at the same time, the troublesome high content of carbon dioxide in the gas produced by existing processes is converted into monoxide.—From the *Colliery Guardian*.

An Additional Blast Furnace was lighted up at the Devonshire Works of the Staveley Coal and Iron Company, Ltd., following the January meeting of the Board of Directors. This makes the full complement of four now in blast.

An Installation of Glover-West Vertical Retorts put into service at YEADON



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The latest installation of Glover-West verticals to be brought into regular operation was started up on December 27th, 1934, at the works of the Yeadon and Guiseley Gas Company. There are 8 retorts in this unit, with a total daily capacity of 800,000 cubic feet of gas.

360 plants are now installed or on order.

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STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Jan. 18.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Sept. 10	7	7	Alliance & Dublin Ord. ...	135—145	...	140
374,000	„	Dec. 17	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
557,655	„	Aug. 13	7	7	Barnet Ord. 7 p.c.	168—178	...	...
300,000	1	Oct. 8	1/9⅔	1/4⅔	Bombay, Ltd.	30/—32/-	+1/-	31/3—31/9
178,480	Stk.	Aug. 13	9½	9½	Bournemouth sliding scale	227—237	...	...
550,050	„	„	7	7	Do. 7 p.c. max. ...	172—177	+2	175½—176
439,160	„	„	6	6	Do. 6 p.c. Pref. ...	150—155	...	...
50,000	„	Dec. 17	3	3	Do. 3 p.c. Deb. ...	86—91	...	...
262,025	„	„	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	„	„	5	5	Do. 5 p.c. Deb. ...	128—133	...	...
357,900	„	Aug. 13	7½	7½	Brighton, &c., 6 p.c. Con. ...	181—186	+1½	184
540,000	„	„	6⅔	6⅔	Do. 5 p.c. Con. ...	160—165	+2	162—165
195,500	„	„	6	6	Do. 6 p.c. B. Pref.	145—150	...	...
1,487,500	„	July 9	5	5	Bristol 5 p.c. max.	120 -122*a*	...	...
120,420	„	Dec. 17	4	4	Do. 1st 4 p.c. Deb. ...	102—104*a*	...	...
217,870	„	„	4	4	Do. 2nd 4 p.c. Deb. ...	102—104*a*	...	...
328,790	„	„	5	5	Do. 5 p.c. Deb.	122—124*a*	...	...
855,000	„	Sept. 24	8	7	British Ord.	174—179	...	176—178
100,000	„	Dec. 17	7	7	Do. 7 p.c. Pref.	160—165	+5	...
120,000	„	„	4	4	Do. 4 p.c. Red. Deb. ...	97—102	...	...
450,000	„	„	5	5	Do. 5 p.c. Red. Deb. ...	111—116	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	—1	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	—3	...
150,000	Stk.	Dec. 17	4½	4½	Do. 4½ p.c. Deb. ...	90—98	...	99½—98
626,860	„	July 23	6	6	Cardiff Con. Ord.	135—140	...	...
287,860	„	Dec 17	5	5	Do. 5 p.c. Red. Deb.	105—110	...	...
157,150	„	July 23	5	5	Chester 5 p.c. Ord.	113—118*b*	...	...
98,986	1	Sept. 24	2/-	2/-	Colombo, Ltd. Ord.	1⅞—1⅞	...	...
24,500	1	„	1/4⅓	1/4⅓	Do. 7 p.c. Pref. ...	19/6—21/6	...	...
609,204	1	Sept. 24	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	19/6—21/6	...	21/4½—21/10½
296,052	1	„	1/8'30	1/8'30	Do. 8 p.c. Pref.	24/6—26/6	...	...
1,775,005	Stk.	July 23	6⅔	5	Commercial Ord.	122—127	...	125
475,000	„	Dec. 3	3	3	Do. 3 p.c. Deb. ...	88—92	+1	90—91½
286,344	„	Aug. 13	5	5	Do. 5 p.c. Deb. ...	125—130	...	128
807,560	„	Aug. 13	7	7	Croydon sliding scale ...	167—172	+2	168—170½
569,590	„	„	5	5	Do. max. div.	116—121	...	120—121
620,385	„	Dec. 17	5	5	Do. 5 p.c. Deb.... ...	130—135	+7	131½—134
642,370	„	Aug. 13	10	7	Derby Con.	200—510*a*	...	...
55,000	„	Dec. 17	4	4	Do. 4 p.c. Deb.	100—105*a*	...	...
909,000	„	Aug. 13	5	5	East Hull Ord. 5 p.c. ...	113—118	...	...
181,625	„	Aug. 13	6	6	East Surrey Ord. 5 p.c. ...	140—145	...	...
175,609	„	Dec. 17	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
1,009,190	„	Sept. 10	†7	†5	European, Ltd.	120—125	...	120—121½
19,315,451	„	Aug. 13	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	28/-—29/-*f*	+-/3	28/4½—28/9
2,600,000	„	„	3¾	3¾	Do. 3½ p.c. max. ...	93—97	...	96—96½
4,477,106	„	„	4	4	Do. 4 p.c. Con. Pref. ...	109—113	...	111—111¾
6,109,497	„	Dec. 3	3	3	Do. 3 p.c. Con. Deb. ...	91—94	+1	90½—94
3,643,770	„	„	5	5	Do. 5 p.c. Red. Deb. ...	118—121	...	...
3,500,000	„	„	4½	4½	Do. 4½ p.c. Red. Deb. ...	117—120	...	118½—119½
270,448	„	Aug. 13	6	6	Harrogate New Cons. ...	140—145	...	...
149,000	1	Sept. 24	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅞—1⅞	...	29/7½—30/-
213,200	Stk.	Aug. 13	6	6	Hornsey Con. 3½ p.c. ...	187—142	...	...
5,600,000	„	Oct. 22	14	10	Imperial Continental Cap.	217—222	—1	218—222
223,180	„	July 23	8½	8½	Do. 8½ p.c. Red. Deb.	92—97	...	95½
335,342	„	Aug. 13	8¾	8½	Lea Bridge 5 p.c. Ord. ...	190—200	...	...
2,167,410	„	Aug. 13	6	6	Liverpool 5 p.c. Ord. ...	144½—145½*b*	...	...
245,500	„	Dec. 17	5	5	Do 5 p.c. Red. Pref. ...	105—110*b*	...	...
306,083	„	Jan. 16	4	4	Do. 4 p.c. Deb. ...	104—107*b**	...	...
11,751	„	Aug. 27	10	8	Maidstone 5 p.c. Cap. ..	188—198	...	...
63,480	„	Dec. 17	3	3	Do. 3 p.c. Deb. ...	83—88	...	...
75,000	„	Dec. 8	†10	†10	Malta & Mediterranean ...	205—215	...	...
393,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—103	...	...
331,978	Stk.	Aug. 13	5	5	M. S. Utility "C." Cons. ...	115—120	...	...
318,657	„	„	4	4	Do. 4 p.c. Cons. Pref.	101—106	...	104½
360,075	„	Dec. 17	4	4	Do. 4 p.c. Deb. ...	102—107	...	...
148,955	„	„	5	†5	Do. 5 p.c. Deb. ...	127—132	...	...
125,000	—	Jan. 2	11/8	3½	Do 3½ p.c. Rd. Rg.Bds.	98—101	...	...
675,000	„	May 28	†6	†13	Montevideo, Ltd.	55—65	...	60
2,061,315	„	Aug. 13	5⅔	5	Newcastle & Gateshead Con.	26/9—27/9*d**	+-/6	...
582,886	„	„	4	4	Do. 4 p.c. Pref. ...	105—107*d*	...	...
776,706	„	Dec. 17	3½	3½	Do. 3½ p.c. Deb. ...	98½—100½*d*	...	...
277,285	„	Oct. 8	5	5	Do. 5 p.c. Deb. '48 ...	105—107*d*	...	...
274,000	„	Aug. 13	5	5	Newport (Mon.) 5 p.c. max.	110—112*a*	...	...
304,940	„	Aug. 13	7½	7½	North Middlesex 6 p.c. Con.	172—177	+2	174
396,150	„	Aug. 13	5	5	Northampton 5 p.c. max. ...	107—112	...	...
300,000	„	Nov. 5	†7	†9	Oriental, Ltd.	168—173	...	171½—172
416,617	„	Dec. 17	8	8	Plym'th & Stonehouse 5 p.c.	180—185	...	...
404,416	„	Aug. 13	8	8	Portsm'th Con. Stk. 4 p.c. Std	183—188	...	188
241,446	„	„	5	5	Do. 5 p.c. max. ...	112—117	...	...
114,000	„	July 23	5	5	Preston 5 p.c. Pref.	110—115	...	...
1,736,958	Stk.	Aug. 27	6	6	Sheffield Cons.	147—149*e*	...	...
95,000	„	Jan. 7	4	4	Do. 4 p.c. Deb.	100—104*e*	...	...
133,201	„	Aug. 13	5	2½	Shrewsbury 5 p.c. Ord. ...	155—160	...	...
90,000	10	May 28	†4	13	South African	3—4	...	3⅔
927,177	1	Sep. 10	1/9⅓	1/2⅔	South-East'n Gas Cn. Ld. Ord.	30/6—32/6	...	30/6
736,061	1	„	-/10⅔	-/10⅔	Do. 4½ p.c. Red.Cum.Pref.	22/6—23/6	...	23/-—23/4½
450,000	Stk.	Aug. 13	74/4	4	Do. 4 p.c. Red. Deb. ...	102—105	...	...
6,709,895	„	Aug. 13	7	6	South Met. Ord.	150—153	+2	149—152
1,135,812	„	„	6	6	Do. 6 p.c. Irred. Pf.	150—155	+1	151½—154
850,000	„	„	4	4	Do. 4 p.c. Irred. Pf.	107—110	...	...
1,895,445	„	Dec. 17	3	3	Do. 3 p.c. Deb. ...	90—93	+1	91½—93
1 000,000	„	Jan. 7	5	5	Do. 5 p.c. Red. Deb.	116—120*	...	119
209,880	„	Aug. 13	8½	8½	South Shields Con.	185—188*d*	...	...
1,543,795	„	July 9	6	6	South Suburban Ord. 5 p.c.	147—152	+3	147½—149½
512,825	„	„	5	5	Do. 5 p.c. Pref.	124—129	...	...
300,000	„	„	4	4	Do. 4 p.c. Pref.	105—110	...	108
866,837	„	Dec. 17	5	5	Do. 5 p.c. Deb.	128—133	...	129—130
100,000	„	„	4	4	Do. 4 p.c. Deb.	107—112	...	...
647,740	„	Aug. 13	5	5	Southampt'n Ord. 5 p.c. max.	118—123	...	...
121,275	„	Dec. 17	4	4	Do. 4 p.c. Deb.	102—107	...	...
350,000	„	Aug. 13	5½	5½	Swansea. 5½ p.c. Red. Pref.	114—119	...	118½
300,000	„	Dec. 17	6½	6½	Do. 6½ p.c. Red. Deb.	100—105	...	...
1,076,490	„	Aug. 13	6⅔	6⅔	Tottenham and District Ord.	163—168	...	165—168
409,835	„	„	5½	5½	Do. 5½ p.c. Pref. ...	133—138	...	...
62,235	„	„	5	5	Do. 5 p.c. Pref. ...	122—127	...	125
199,005	„	Dec. 3	4	4	Do. 4 p.c. Deb. ...	102—107	...	...
349,110	„	Aug. 13	7	7	Uxbridge, &c., 5 p.c. ...	167—172	+2	168½
88,330	„	„	5	5	Do. 5 p.c. Pref. ...	124—129	...	...
1,926,700	„	Aug. 13	7	7	Wandsworth Consolidated	168—173	...	170½—173
1,371,373	„	„	5	5	Do. 5 p.c. Pref.	127—132	...	180½
1,317,964	„	Dec. 17	5	5	Do. 5 p.c. Deb.	130—135	...	135—135
208,300	„	„	...	26/8	Do. 4 p.c. Deb.	104—109	...	...
158,400	„	Aug. 13	6*g*	5	Winchester W. & G. 5 p.c. Con.	120—125	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g.*—Paid £8, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

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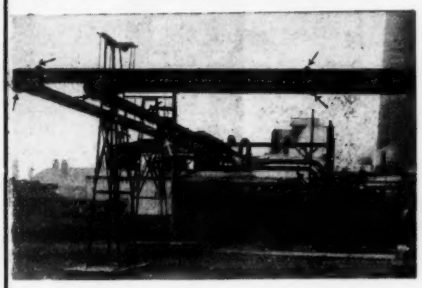
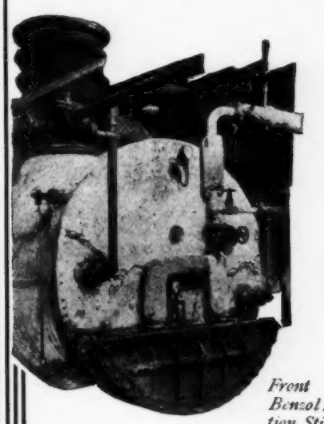


Two Steam Mains, one at a Pressure of 170 lbs. per square inch, the other at 20 lbs per square inch.



Front View of Benzol Rectification Still. Pressure on Steam Chest, about 80 lbs.

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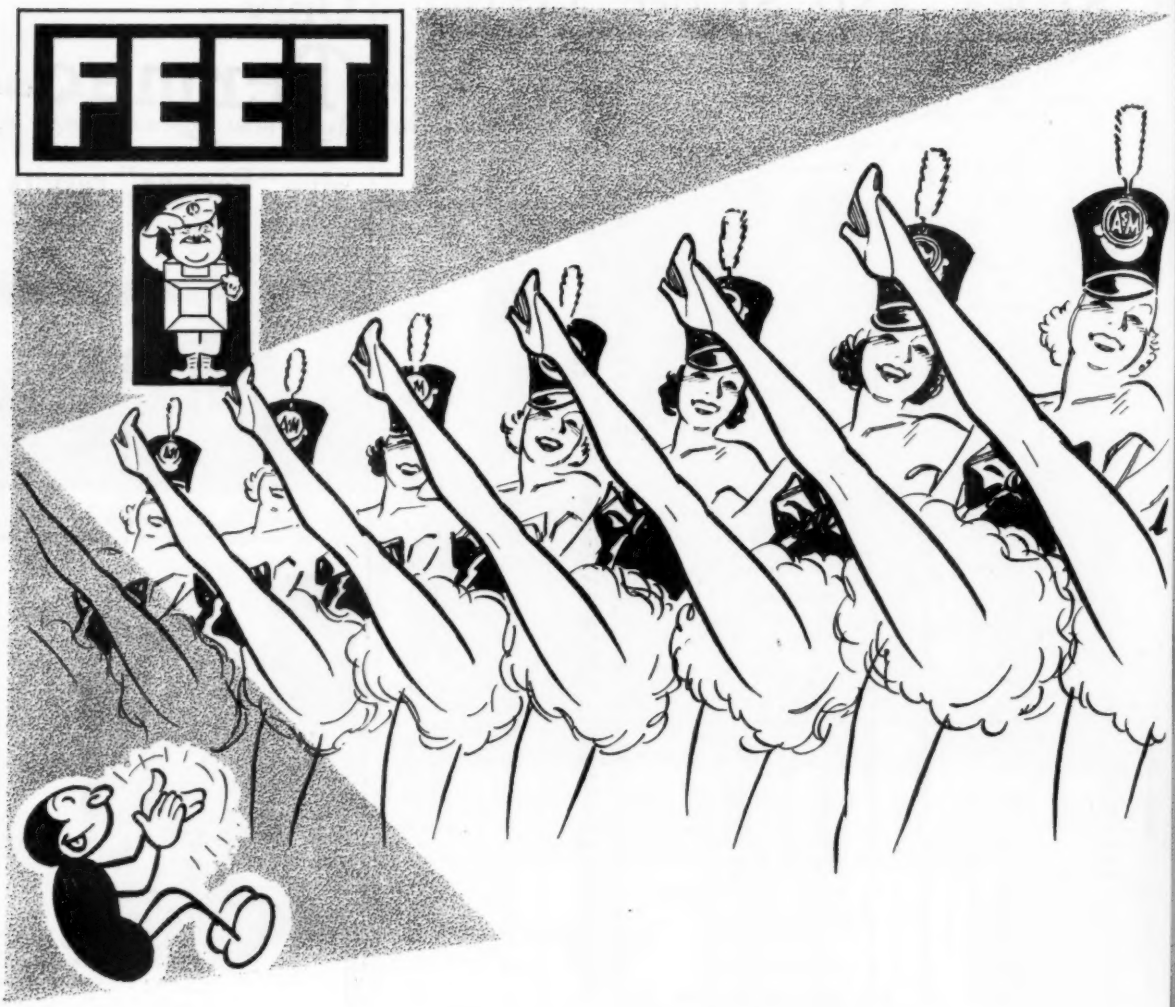

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